Welch Allyn

Service Manual

# Spot Vital Signs

PN 95P506E
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# Spot Vital Signs Service Manual

# Revision History

| Version | Date | Author | Description |
|---|---|---|---|
| A | 3/31/01 | JDB | Introduction of Service Manual |

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# Section 1 General Information

## *1.1-To Service Personnel:*

Read and understand the Spot Vital Signs Operator's Manual and this Service Manual. The information contained in both of these publications is subject to change without notice and should not be construed as a commitment by Welch Allyn, Inc.

Welch Allyn assumes no responsibility for any errors that may appear in this manual. If the product and/or its operation varies significantly from any description herein, please contact the following:

WELCH ALLYN,, INC. TECHNICAL SERVICE DEPARTMENT:
1-800-450-9275
(828) 684-4895
Fax (828)687-1002

Welch Allyn,, Inc. .
95 Old Shoals Road
Arden, North Carolina 28704

This product has been designed to provide a high degree of safety and reliability. However, we can not guarantee against: deterioration of components due to aging, normal wear, tampering, and abuse.

All service and repairs must be performed by authorized Welch Allyn personnel or agents, using approved Welch Allyn replacement parts and approved process materials. Failure to so will invalidate the product warranty. Please refer to the product warranty for specific coverage.

Welch Allyn, Inc.
95 Old Shoals Road
Arden, North Carolina 28704
USA
1 800 450-9275

## *1.2 Limited Warranty*

Welch Allyn, Inc. warrants the Spot Vital Signs, when new, to be free of defects in material and workmanship and to perform in accordance with manufacturer's specifications for a period of two years from the date of purchase from Welch Allyn, Inc. or its authorized distributors or agents. Welch Allyn, Inc. will either repair or replace any components found to be defective or at variance from manufacturer's specifications within this time at no cost to the customer. It shall be the purchaser's responsibility to return the instrument to Welch Allyn, Inc. or an authorized distributor, agent or service representative. This warranty does not include breakage or failure due to tampering, misuse, neglect, accidents, modification or shipping. This warranty is also void if the instrument is not used in accordance with manufacturer's recommendations or if repaired by other than Welch Allyn, Inc. or an authorized agent. Purchase date determines warranty requirements. No other express warranty is given.

To receive service assistance or to ask questions regarding this warranty, please call or write:
Welch Allyn, Inc. Technical Services Dept.
95 Old Shoals Road
Arden, North Carolina 28704 USA
1 (800) 450-9275 or (828) 684-4895
Fax: (828) 687-1002

### Service Policy

All repairs on products under warranty must be performed or approved by a Welch Allyn, Inc. Service Center. *Unauthorized repairs will void the warranty*. Products out of warranty should be repaired by qualified electronics personnel or a Welch Allyn, Inc. Service Center.

### Technical Assistance

If you have an equipment problem that you cannot resolve, call the Welch Allyn, Inc. Service Center nearest you for assistance. Technical service support is available to you by telephone on normal business days at the locations listed on the next page

***Before returning a product for repair you must obtain authorization from Welch Allyn, Inc. An RMA (Return Material Authorization) number will be given to you by our service personnel. Be sure to note this number on the outside of your shipping box. Returns without an RMA number will not be accepted for delivery.***

## Welch Allyn, Inc. Service Centers

For Service or Repair

**USA Customers**

**Welch Allyn, Inc.**
Technical Service Centers
95 Old Shoals Road
Arden, NC 28704-9739 USA
Phone: 828-684-4895
Fax: 828-687-1002

**CANADA Customers**

**Welch Allyn Canada Limited**
Technical Service Centers
160 Matheson Blvd., East
Mississauga, Ontario L4Z CANADA
Phone: 905-890-0004 or 1 800-561-8797
Fax: 905-890-0008

**INTERNATIONAL Customers**

**Welch Allyn GmbH**
Technical Service Center
Zollerstrasse 2-4 Road
D-72417 Jungingen
GERMANY
Phone: [49]-7477-927-10
Fax: [49]-7477-9271-90

**Welch Allyn Australia Pty. Ltd.**
Technical Service Center
5/38-46 South Street
Rydalmere NSW 1701
AUSTRALIA
Phone: [61] 29-4183-155
Fax: [61] 29-4183 650

**Welch Allyn Ltd.**
21-09 Golden Mile to 6001
Beach Road
Singapore 199589
REPUBLIC OF SINGAPORE
Phone: [65]-291-0882
Fax: [65]-291-5780

**Welch Allyn UK Ltd.**
Cublington Road
Aston Abbots
Buckinghamshire HP22 4ND
UNITED KINGDOM
Phone: [44] 129-668-2140
Fax: [44] 129-668-2104

**LATIN AMERICA Customers**

**MDI International**
Technical Service Centers
7324 SW 48th Street
Suite A
Miami, FL 33155 USA
Phone: (305)-669-9591
Fax: (305)-669-1971

## *1.3 Basic System Description*

### Introduction

The Welch Allyn Spot Vital Signs is designed to non-invasively and automatically measure systolic and diastolic pressure, pulse rate, temperature and oxygen saturation (SpO2 ) for adult and pediatric patients. THE WELCH ALLYN SPOT VITAL SIGNS IS NOT INTENDED TO BE USED ON NEONATAL PATIENTS. All blood pressure, pulse, temperature and SpO2 values can be viewed on a large, easy-to-read display, and may be printed via the IrDA port to an external printer as desired. The rechargeable lead acid battery and variety of mounting accessories make the Welch Allyn Spot Vital Signs convenient for many locations. The operator may choose any combination of simultaneous measurement modalities. The Welch Allyn Spot Vital Signs is intended for use in a wide variety of health care settings. This includes hospital departments, as well as alternate care settings, such as physicians offices, clinics, and long term care facilities. The Welch Allyn Spot Vital Signs is not intended for continuous monitoring of patients, or for use during transport of a patient. The Welch Allyn Spot Vital Signs is not intended for use in environments that are not supervised by a health care practitioner.

Refer to the Spot Vital Signs Operator's Manual for complete information on Indications For Use, Special Features, Supplies and Accessories

### *1.4 Basic System Operation*

## Blood Pressure Measurements

A single blood pressure determination is made when the blood pressure START/STOP button is pushed.

A measurement cycle may be cancelled at any time by pressing the BP START/STOP button again. This action immediately initiates a rapid cuff deflation.

The blood pressure measurement data will appear on the display immediately following the measurement and remain displayed for two minutes. After two minutes, the display goes blank, and the device will go into standby mode. The most recent BP measurement may be recalled by pressing the Print, Mode, Next Patient/Clear or BP Start/Stop button.

**Max/Min Blood Pressure Ranges**

The maximum and minimum ranges of blood pressure are detailed below:

| Measurement | Maximum | Minimum |
|---|---|---|
| Systolic Pressure | 250 mmHg | 60 mmHg |
| Diastolic Pressure | 160mmHg | 30 mmHg |

## Mean Arterial Pressure (MAP)

Ranges 40 - 190mmHg

Calculated from Systolic and Diastolic data (not directly measured).

## Temperature Operating Modes

Thermometry measurements are made with the Welch Allyn SureTemp ™ technology. Oral and rectal probes utilize single-use disposable probe covers that limit cross-contamination. Oral, axillary or rectal temperatures are taken using ‘Normal or ‘Monitor operating modes. Axillary temperatures are taken using the (blue) oral probe.

Rectal temperatures are taken using the (red) rectal probe. In the Normal mode the thermometer's microprocessor "predicts" body temperature in about 4 seconds for oral temperatures, about 10 seconds for axillary temperatures, and in about 15 seconds for rectal temperatures. The monitor mode displays the patient's actual temperature after 3 minutes for oral/ rectal mode and 5 minutes for axillary mode, and will continue to display an updated temperature as long as the probe remains in place. Temperature readings may be displayed in Fahrenheit or Celsius scales.

**Max/Min Temperature Ranges**

| Measurement | Maximum | Minimum |
|---|---|---|
| Temperature | 109.4°F<br>43.0°C | 86.0°F<br>30.0°C |

**Temperature Normal Mode**

In Normal Mode, the Spot Vital Signs will measure temperature at discrete intervals and then calculate the rate of change according to a proven algorithm. This allows the thermometer to predict the end point that the thermistor would reach if it were left in the mouth until it reached mouth temperature. This predictive feature allows the thermometer to arrive at an accurate oral temperature reading in approximately 4 seconds.

Normal mode is the default operating mode for the temperature determinations.

Operator selectable patient alarm limits are not available in temperature Normal mode. However, temperatures that are outside of the operating range of the device will be noted on the temperature display.

**Temperature Monitor Mode**

Continuous Monitor Mode operation is normally used when difficult situations prevent accurate temperatures from being taken in the Normal mode. The probe must be in contact with tissue for at least three minutes for accurate oral/rectal temperature measurement and five minutes for accurate axillary temperature measurement. Monitor mode temperatures may not be identical to predicted 'Normal' temperatures because of ambient temperature influence and other factors The trend in temperature is the important standard to be observed when in the Monitor mode. Operator selectable patient alarm limits are not available in temperature monitor mode. However, temperatures that are outside of the normal operating range of the device will be noted on the temperature display.

# SpO2 Operating Mode

* The Spot Vital Signs incorporates the Nellcor Puritan Bennett ™ pulse oximetry system which determines arterial oxyhemoglobin saturation (SpO2 %) by measuring the absorption of red and infrared light passed through the tissues.

* Changes in absorption caused by pulsation of blood in the vascular bed are used to determine arterial saturation and pulse rate. Oxygen saturation percent is calculated with each pulse detected, and thus the device display is continually updated. The pulse signal bar graph is an indicator of the strength and quality of the detected pulses.
* The Spot Vital Signs is capable of determining pulse rate as an adjunct to the blood pressure measurement and the SpO2 measurement.
* The pulse rate, in beats per minute, will be determined primarily from the SpO2 measurement methodology. In the case where SpO2 is not available, or is disabled, the pulse rate display will be driven from data collected as part of the blood pressure measurement method.
* Removal of the SpO2 sensor from the patient will initiate an audible beep, to alert the user that the sensor has been disconnected.
* SpO2 is generally measured via pulses detected using a finger sensor, and performs most accurately with the finger clip sensor. The finger clip sensor may be used on all fingers except the thumb. For certain situations SpO2 may be measured at alternate sites including the earlobe, forehead and toes. Special sensors must be employed in these situations. The finger clip sensor is recommended for spot checks or short-term evaluation (less than 60 minutes). Patient supervision is required as the Spot Vital Signs has no alarm capability.
* Oxygen Saturation and pulse rate is displayed on the LCD display. On each detected pulse, the pulse signal bar graph flashes. The intensity of this signal is a simple visual indicator of waveform signal strength, and can identify situations where the pulsatile nature of the tissue may not be adequate for an accurate SpO2 reading. The update interval bar of the bar graph should correspond to the patient's pulse rate. This is an indication of the quality of the SpO2 signal.

**Max/min SpO2 Ranges**
The SpO2 sensor is designed to detect oxygen saturation as follows:

| | Maximum | Minimum |
|---|---|---|
| $SpO_2$ | 100% | 40% |

# Pulse Rate Feature

The Welch Allyn Spot Vital Signs is capable of determining pulse rate as an adjunct to the blood pressure measurement and the SpO2 measurement. The pulse rate, in beats per minute, will be determined primarily from the SpO2 measurement methodology. In the case where SpO2 is not available, or is disabled, the pulse rate display will be derived by data from the blood pressure measurement method.

### Max/Min Pulse Rate Ranges

The maximum and minimum pulse rate ranges are as follows:

| Maximum | Minimum | |
|---|---|---|
| 200 bpm | 40 bpm | Using B.P. determination |
| 245 bpm | 25 bpm | Using $SpO_2$ determination |

## *1.5 Specifications*

The performance specifications of the Spot Vital Signs are as follows:

**Patient Population**
The Welch Allyn Spot Vital Signs is designed for use with adult and pediatric patients. Welch Allyn defines a pediatric patient as 29 days old and above. THE SPOT VITAL SIGNS IS NOT INTENDED FOR USE WITH NEONATES. Welch Allyn defines neonates as children 28 days or less of age born at term (37 weeks gestation or more): otherwise, up to 44 gestational weeks.

**Cuff Pressure Range**
0 mmHg - 300mmHg

**Initial Cuff Inflation**
160 mmHg, smart inflation

**Systolic Determination**
Maximum: 250 mmHg
Minimum: 60 mmHg

**Diastolic Determination**
Maximum: 160 mmHg
Minimum: 30 mmHg

**Blood Pressure Accuracy**
Blood pressure accuracy meets or exceeds SP10-1992 AAMI standards for non-invasive blood pressure accuracy (AAMI standard: ± 5 mmHg mean error; 8 mmHg standard deviation). Blood pressure accuracy is validated for pressure measurement using the upper arm only.

**Blood Pressure Determination Time**
20 seconds to 45 seconds typical, 165 seconds maximum.

**Pulse Rate Determination (Using SpO2 determination)**
Maximum: 245bpm
Minimum: 25bpm

**Pulse Rate Accuracy**
SpO2 Module Heart Rate ±3.0 bpm
Blood Pressure Algorithm Heart Rate ±5.0

**Overpressure Cutoff**
315 mmHg ±15 mmHg

**Temperature Ranges**

| Measurement | Maximum | Minimum |
|---|---|---|
| Temperature | Max 109.4°F<br>Max 43.0°C | Min 86.0°F<br>Min 30.0°C |

**Temperature Accuracy**
Temperature accuracy meets or exceeds ASTM E112-86: "Standard Specification for Electronic Thermometer for Intermittent Determination of Patient Temperature."

**Temperature Determination Time**
(Oral) 4 seconds typical, 15 seconds maximum
(Axillary) 10 seconds typical
(Rectal) 15 seconds typical

**Oxygen Saturation Range (SpO2 %)**
40-100% oxygen saturation

**SpO2 Accuracy**
±3% in the range of 70-100% oxygen saturation (1 Standard Deviation)
<70% unspecified by the OEM.

**Battery Charging**
To 90%-100% capacity in 12 hours. Unit will operate and charge battery simultaneously when connected to power source.

# Mechanical Specifications

**Dimensions**
Height 9.70 inches (24.64 cm)
Length 5.72 inches (14.53 cm)
Depth 4.73 inches (12.01 cm)

**Weight**
Approximately 4.25 pounds

**Mounting**
Self-supporting on rubber feet
Custom Mobile Stand
Custom Made Wall Mount

**Portability**
May be hand carried when held by the rear handle.

# Electrical Specifications

**Power Requirements**
Patient-Rated isolation transformer is connected to AC mains:
North American Version: 120VAC, 60 Hz. 0.20A Input Source, 8VDC, 0.75A Output Source
International Version: 220-240VAC, 50-60Hz 0.20A Input Source, 8VDC, 0.75A Output Source
**Battery**
Lead acid, with external charger.
A fully charged battery will support **150**"typical" blood pressure determinations taken at 7 minute intervals. Battery is 90-100% charged after 6-12 hours of charging. The battery automatically charges when the Spot Vital Signs is powered through the AC power transformer. The battery will charge faster when the instrument is not in operation.

# Environmental Specifications

**Operating Temperature**
+10°C to +40°C (Except temperature 16°C to 40° C)
+50°F to +104°F

**Storage Temperature**
-20°C to +50°C
-4°F to +122°F

**Relative Humidity**
15 to 90% (non-condensing)

**Operating Altitude**
-170m to +4877m
-557ft. to +16,000ft.

### *1.6 Identification Label and Serial Numbering System Defined*

The identification label for the 420 Series Spot Vital Signs is shown below. It is located on the bottom of the unit.

The serial number for the device would consist of nine (9) numbers and a bar code. These would be located in the square below the words "420 Series." An example of the number and the explanation is shown below:

***200100001***

The four digits on the left Are the year of manufacture of the device.
The five digits on the right are the sequence of build starting with 00001 annually.

(The example number above would be the first unit built in 2001)

## *1.7 Firmware Identification*

To confirm the software levels of the 420 Series Spot Vital Signs, place the unit into the "Configuration Test" mode by holding down the ***Start*** button while the unit is being powered up.

The main software versions will appear as follows:
* In the SW1 Screen, the top two numbers is the software version of the Spot Module and the other numbers are for the SpO2 module (if installed). Press the "Start" or "Clear" button to cycle through the SpO2 software number.

In the SW2 screen, The two numbers represent the NIBP module software and the Temperature Algorithm Version (If temperature is active.).

***Note:*** *Verify the firmware levels by reviewing the Repair Test Specifications document.*

# Section 2 Service

## *2.1 Intent of Manual and Product Scope.*

This manual provides technical service and re-calibration information to technicians authorized to repair and recalibrate Welch Allyn, Inc. products. When used in conjunction with the required test equipment and tools, technicians will be able to diagnose, repair, and recalibrate, and test the Spot Vital Signs.

The manual includes: Re-calibration instructions, fault/cause analysis, step by step disassembly and re-assembly procedures, repair, adjustment, and re-test procedures.

## *2.2 Test Equipment Bench Layout:*

Figure 2.2 depicts recommended layout of test equipment and special tools for service and re-calibration of the Spot Vital Signs.

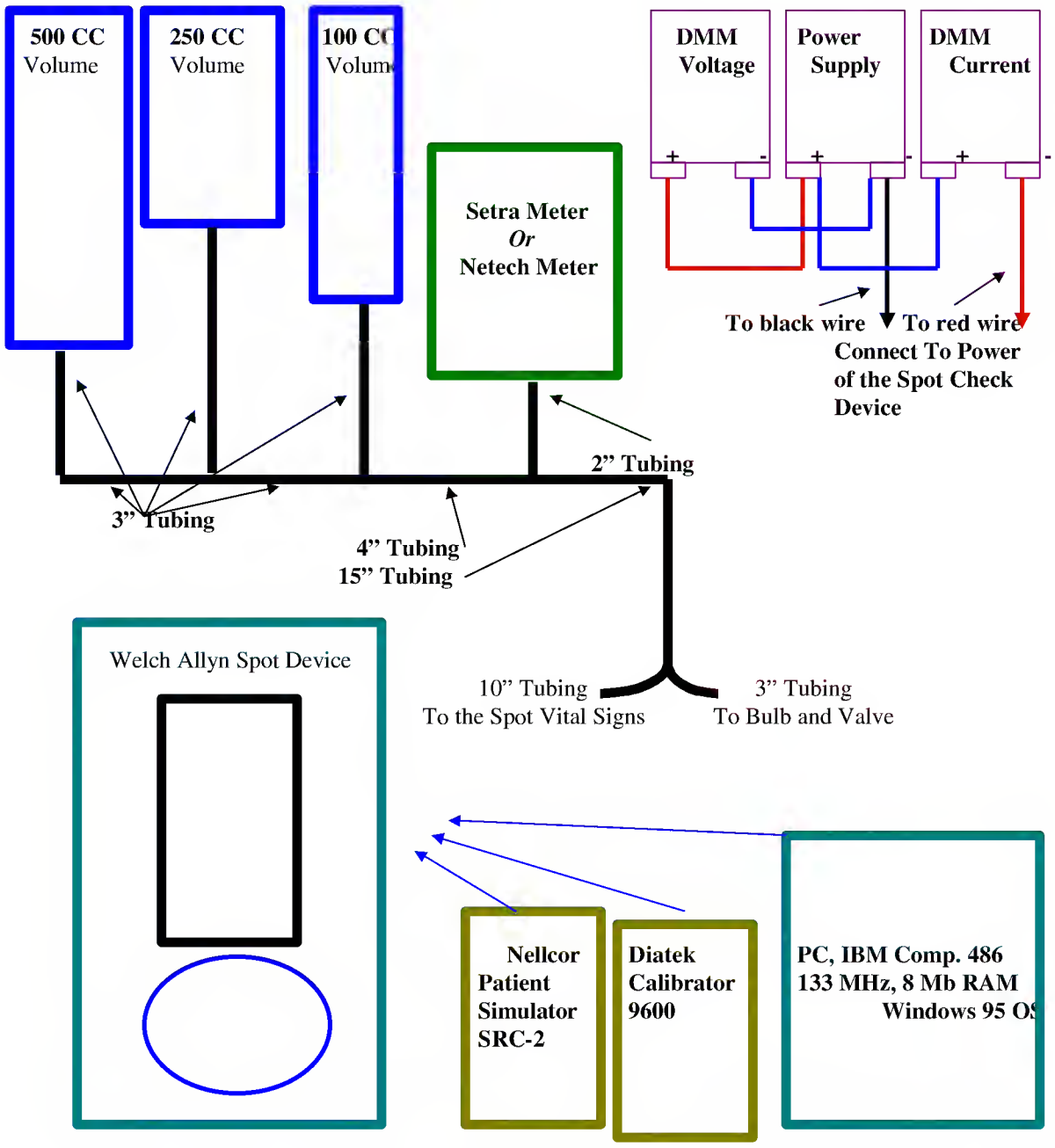



***FIGURE 2.2***

BENCH LAYOUT FOR RE-CALIBRATING AND TESTING SPOT VITAL SIGNS

## *2.3 Required Tools and Fixtures for Service*

Special tools below can be ordered from Welch Allyn, Inc.

| **DESCRIPTION** | **TOOL #** |
|---|---|
| 100cc TEST VOLUME | T112819 |
| 250cc TEST VOLUME | T112818 |
| 500cc TEST VOLUME | T112854 |
| DIGITAL TIMER | 8456T12 |
| PLIERS | T112458 |
| BULB AND VALVE | 5088-01 |
| WIRE CUTTERS | T112486 |
| TWEEZERS | T112511 |
| PNEUMATIC TUBING (3 ea.) | 5089-12 |
| "Y" FITTING | 9586TPK4 |
| "T" FITTING (3) | 9585TPK4 |
| TEST CABLE (IR) | 66P824 |
| TEST CABLE (Service Cable Kit) | 66S553 |
| PNEUMATIC CLAMPS (3) | 21730-001 |
| TORQUE SCREWDRIVER | T112917 |
| TORQUE SCREWDRIVER | T112918 |
| TORQUE DRIVER | T112918A |
| CUSTOM REPAIR SOFTWARE | 130S57 |
| #4 PHILLIPS BIT | T112919 |
| T10 TORX BIT | T114030 |
| 3/8 HEX SOCKET | T114135 |
| CABLE TIE TOOL | T112845 |
| DIATEK 9600 CALIBRATOR | 01800-210 |
| DIATEK CAL. KEY | 06137-000 |
| NELLCOR PATIENT SIMULATOR | SRC-2 |
| NELLCOR TEST CABLE | EC-8 |
| SERVICE MANUAL | 4200-145E |
| **DIGITAL PRESSURE METERS** | |
| SETRA METER (0-10 PSIG) | ***2270-01*** |
| NETECH METER | ***200-2000IN*** |
| ***Notes:*** The entire set of equipment listed above can be ordered through Welch Allyn by the following number: ***Eleckit*** | |
| A *Setra Meter (2270-01)* or a *Netech Meter (200-2000 IN)* must to be ordered along with the ***Eleckit.*** | |
| Individual equipment numbers can be ordered by themselves. | |
| NO DISCOUNTS | |

## *2.4 Required Tools and Fixtures for Service*

The following equipment is need for service/repair and can not be obtained from Welch Allyn, Inc.

- IBM compatible 486 133 MHz computer or better. The computer must have Windows 95 with a serial port. CPU must have 8 Megabytes of RAM.

- 2 Digital Multi-Meters. These meters must have 4 1/2 digit displays for accuracy.

- Power Supply. 0-20 Vdc adjustable with 0-3A output.

- Oscilloscope. 60 MHz minimum.

### *2.5-Replacement Parts :*

| Drawing Number Reference* | Part # | Description |
|---|---|---|
| 1 | 421100-502 | Main PCB |
| 2 | 421030 | Flex Cable; Main to Display |
| 3 | 421023-501 | Pump Sub-assembly |
| 4 | 421045 | IR Window |
| 5 | 421020-501 | Display Module |
| 6 | 421002-501 | Battery Assembly |
| 7 | 421029 | Cable Assembly (Power) |
| 8 | 421040 | Rear Housing |
| 9 | 421049-502 | Front Housing Assembly |
| 10 | 421044 | Temperature Pod Housing |
| 11 | 421048 | SpO2 Cover |
| 12 | 421042 | Battery Cover |
| 13 | 421047 | SpO2 Latch |
| 14 | 421009 | Key Pad |
| 15 | 421105-501 | Temperature Assembly PCB |
| 16 | 125S222 | Nellcor SpO2 PCB |
| 17 | 421099 | Cable Assembly (pump/valve - Pneutronics Valve) |
| 18 | 121S106 | Pneutronics Valve |
| 19 | 421066 | Flex Cable, Temperature to Main PCB |
| 20 | 421001-502 | Pneumatic Assembly |

** - Numbers corresponding to the parts shown in the exploded view drawing in section 6.*

### *2.6-Supplies and Accessories:*

The following parts can be purchased by the end user as well as the authorized repair sites.

## Blood Pressure Accessories And Supplies- Latex Free

## Cuff and Bag Combination

5200-01 Adult (cuff, bladder and connector)
5200-02 Large Adult (cuff, bladder and connector)
5200-03 Small (cuff, bladder and connector)
5200-10 Thigh (cuff, bladder and connector)

## Durable One-Piece Cuff

5200-13 Small Child (one-piece cuff and connector)
5200-14 Child (one piece cuff and connector)

5200-15 Small Adult (one piece cuff and connector)
5200-16 Adult (one piece cuff and connector
5200-17 Lg. Adult (one piece cuff and connector)
5200-18 Extra Large Adult (one piece cuff and connector)

## Disposable Monitor Style One-Piece Blood Pressure Cuff

5082-93-3 Small Child Cuff
5082-94-3 Child Cuff (white)
5082-94P-3 Child Cuff (print)
5082-95-3 Small Adult Cuff
5082-96-3 Adult Cuff
5082-97-3 Large Adult Cuff
5082-98-3 Thigh Cuff

## Miscellaneous

5082-59 Cuff: Adult
5082-61 Cuff: Large Adult
5082-63 Cuff: Child Print
5082-64 Cuff: Thigh
5200-04 Bladder: Adult (includes connector)
5200-05 Bladder: Large Adult (includes connector)
5200-06 Bladder: Child (includes connector)
5200-11 Bladder: Thigh (includes connector)
5200-07 Coiled Pressure Hose (8ft.) (2.4M) *Note: One additional hose may be connected to provide extended length. All appropriate connectors are included.*
5200-12 Straight Pressure Hose (8ft.) (2.4M)
5200-08 Calibration T-Connector

## Temperature Accessories And Supplies

02678-100 Oral Probe: (9ft.) (2.7M)
02679-100 Rectal Probe: (9ft.) (2.7M)
05031-101 Disposable Probe Covers (1000 covers, packaged 25/box)
06137-000 Temperature Calibration key
01800-210 Model 9600 Temperature Calibration Kit, 110v

## Nellcor Puritan Bennett ™ Pulse Oximetry Accessories And Supplies

DS-100A DURASENSOR ® Adult Oxygen Transducer
EC-8 Extension Cable (8ft.)
D-YS DURA-Y ® Oxygen Transducer (1 sensor, 40 wraps)
D-YSE Ear Clip, (use with Dura-Y sensor)
D-YSPD PediCheck ™ Pediatric Spot Check (use with Dura-Y sensor)
D-25 OXISENSOR ® II Adult Digit Oxygen Transducer (case of 24)
D-25L OXISENSOR ® II Adult Digit Oxygen Transducer, long cable (case of 24)

D-20 OXISENSOR ® II Pediatric Oxygen Transducer (case of 24)
I-20 OXISENSOR ® II Infant Digit Oxygen Transducer (case of 24)
R-15 OXISENSOR ® II Adult Nasal Oxygen Transducer (case of 24)
OXICLIQ ® A Adult Oxygen Transducer, use with OC-3 cable (case of 24)
OXICLIQ ® P Pediatric Oxygen Transducer, use with OC-3 cable (case of 24)
OC-3 OXICLIQ ® Sensor Cable
OXI-A/N OXIBAND ® Adult/ Neonatal Oxygen Transducer (1 sensor, 50 wraps)
OXI-P/I OXIBAND ® Pediatric/ Infant Oxygen Transducer (1 sensor, 50 wraps)
RS-10 Reflectance Oxygen Transducer (6 sensors, 6 headbands)
SRC-2 Portable Oximetry Tester

## Mounting Accessories And Supplies

4200-60 Complete Mobile Stand Unit
*includes: Storage Basket Pole and Base Assembly Transformer Mounting Kit*
4200-62 Complete Wall Mount Unit
*includes: Storage Basket Wall Mount Bracket Transformer Mounting Kit Recommended.*
4200-64 Complete IV Pole Mount Unit
*includes: Storage Basket, IV Pole Mount Bracket, Transformer Mounting Bracket.*
4200-70 Anti-Theft Kit for Mounting Device

## Miscellaneous Supplies

14042 Thermal Printer
14052 Thermal Printer with Mobile Stand Mount
53600 Printer Paper (1 case, 6 boxes, 24 rolls)
53600B Printer Paper (4 roll box)
4200-84 Lead Acid Battery
4200-85E Operator Manual
421054-1E Quick Reference Card
4200-145E Service Manual
4200-100 Welch Allyn Spot Vital Signs Carrying Case
5200-101A AC Power Transformer *(desktop transformer, line cord not included) -North American Version*
5200-102A AC Power Transformer *(desktop transformer, line cord not included) -European Version*
5200-103A AC Power Transformer *(desktop transformer, line cord not included) -United Kingdom Version*
4200-110 Line Cord (United States/Canada/Japan version)
4200-111 Line Cord (European version)
4200-112 Line Cord (United Kingdom version)
4200-113 Line Cord (Australian version)

## *2.7 Maintenance and Service Support*

**Owner Maintenance:** Non-Technical customers can perform normal maintenance per the instructions provided in the Operator's Manual. End users will be able to perform basic operations such as replacement of: hoses, cuffs, probes, and batteries. On this level the unit will not be opened (except for the battery housing). Opening of the Spot Vital Signs by untrained individuals will damage the unit and void the warranty.

**Technical Service/Repair/Re-calibration:** Properly trained and equipped bio-medical departments and service centers will be able to utilize the content of this Service Manual. Technical skills in electronics and PC skills are required. These departments and centers must have service manual and re-calibration software, repair tools and test equipment as listed in this manual.

***Note: Welch Allyn, Inc. recommends that the calibration of the Spot Vital Signs be checked on a yearly basis for BP, Temperature and SpO2 (if applicable).***

# Section 3 Problem Diagnosis

## *3.1 Diagnostic Procedure for Returned Units*

**NOTES**:
A. The word "unit" in this text refers to the Spot Vital Signs.
B. "MenulChoice" represents menu commands. Rather than use the phrase "choose the exit command from the File menu."

1. Remove the battery from the unit. Connect the unit to the power supply. Set the power supply to 6.5 Vdc +/- 0.2 Vdc.

2. With a digital multi-meter, check the voltage of the battery. If the voltage of the battery is less than 6.0 Vdc, the battery needs to be charged. Up on completion of this procedure, place the battery back into the unit and plug up the charger. Let the battery charge for 8 hours. Next allow the unit to set for 1 day and recheck the battery voltage. If the voltage is below 6.0 Vdc, change the battery. **(Reference section 4.1 page 39)**

3. Power up the unit. If the unit does not power up:
   A. Insure the power supply is on and has the correct requirements as called out for in the repair manual.
   B. The power supply is connected to the unit and turned on.
   C. Check that the fuse is not blown. **(Reference section 4.6 page 44)**
   D. Change the main PCB. **(Reference section 4.6 page 44)**
   E. Change the display PCB. **(Reference section 4.4 page 42)**

**If the unit does power up:**
4.To check the display PCB, observe the unit during power up. All of the LCD segments should be lit for 1-2 seconds before the unit gets to its normal mode. If the unit has any LCD segments out change the display PCB. **(Reference section 4.4 page 42)**

5. Run a couple of blood pressure cycles to insure proper inflation/deflation and readings.

6. If the unit is not inflating/deflating properly:
   A. Open up the unit by removing the 4 housing screws.
   B. Check the unit for pinched tubing if the unit is deflating too slow. With the housing opened, re-run the blood pressure cycle to see if the deflating problem has been fix. Re-route tubing if pinch is found.
   C. If there are no pinched tubes, change the valve. **(Reference section 4.8 page 46)**
   D. Power down the unit. Place unit into configuration test mode by holding down the "start" button as power is re-applied. Press the mode button until "cal" appears in at the top of the LCD window.

Press the "start" button to close the valve. Pump up the unit using the bulb and valve inflate the unit to 250 mmHg. Confirm the unit meets the specification for leak called out in the Repair Test Specification document. If the unit is leaking:

E. Pinch off the tubing leading to the pump. If this stops the leak, change the pump. **(Reference section 4.8 page 46)**
F. Pinch off the tubing leading to the valve. If this stops the leak, change the valve. **(Reference section 4.8 page 46)**
G. Pinch off the tubing leading to the transducer. If this stops the leak, change the Main PCB. **(Reference section 4.6 page 44)**

7. If the unit is inflating/deflating properly however there is no reading given, change out the main PCB. **(Reference section 4.6 page 44)**

8. **FOR THE SPO2 OPTION**: Connect the patient simulator to the unit SpO2 connection by the Nellcor SpO2 cable. Confirm readings equal to the specifications called out in the Repair Test Specifications document. If there is no reading, change out the SpO2 PCB. **(Reference section 4.7 page 45)**

9. **FOR THE TEMPERATURE OPTION**: Remove the temperature probe and view the temperature window on the display. Make sure the temperature is in the "monitor mode." This will be displayed at the bottom of the window. If the unit is not in monitor mode, wait approximately 40-60 seconds and the unit will automatically transfer into the monitor mode. Using the Diatek 9600 calibrator set at 96.4 F/ 35.8 C or using a water bath between 84 F and 106 F, place the probe into the small hole on top of the 9600 calibrator or into bath. If there is no reading place the probe back into its housing, remove and retry. If there is still no reading, change the probe and retry the test. If there is still no reading place the probe back into the housing, unplug the probe and plug in the cal-key (5200-25), remove the probe and Confirm reading meets specifications called out on the Repair Test Specification document. If there is no reading at this point, change the temperature connector PCB and cable to the main PCB. **(Reference section 4.2 page 40)**

10. **FOR THE COMMUNICATION OPTION**: Select ***Tools\Options*** to insure that the communication port that the cable is connected to is selected. Select "test" and ensure that the Spot Device responds accordingly. If an error is present, ensure that there is no obstacles in the way of the IR window and re-try the test. If the error is still present, change out the main PCB. **(Reference section 4.6 page 44)**

**End of section 3.1**

## *3.2 Calibration Procedure : Voltage*

VOLTAGE CALIBRATION

1. Connect the unit to the test station by hooking up the pneumatic tubing, and removing the battery and connecting the power supply. Ensure that there are no obstacles in the way of the IR window. Adjust the power supply to 5.5 +0.2/-0 Vdc.
2. Place the unit into the "configuration test mode" by holding down the start button while powering up the unit. Allow the software versions to be displayed then press the mode button until the unit displays "BAT" in the LCD window.
3. Go to the repair software and choose ***Calibrate\|Voltage***.
4. View the digital multi-meter (DMM) that is connected to the power supply reading the voltage. Move the cursor to the "Calibrated Voltage" box and type in the voltage that you observe on the DMM. In the software, select "Update."
5. The software will then prompt you to enter in a "Calibration Signature." Move the cursor to the box and enter the three initials of your name. Then select "OK."
6. At this point you should see the voltage on the LCD display of the unit change to match that of the DMM.

**END OF SECTION 3.2**

## *3.3 Calibration Procedure : Pressure*

PRESSURE CALIBRATION

1. Connect the unit to the test station by hooking up the pneumatic tubing, removing the battery and connecting the power supply. Ensure that there are no obstacles in the way of the IR window. Ensure that the voltage of the power supply is 6.5 +/- 0.2 Vdc.
2. Place the unit into the "configuration test mode" by holding down the start button while powering up the unit. Allow the software versions to be displayed then press the mode button until the unit displays "CAL" in the LCD window.
3. Go to the repair software and choose ***Calibrate\Manometer***.
4. Ensure that the valve is "open" and select "Calibrate 0."
5. Once this is completed successfully, close the valve by pressing the "start" button.
6. Ensure that the 500cc volume is the only volume in the system, and increase the pressure to 250 +/- 5 mmHg using the bulb and valve.
7. Place the cursor into the box below the "calibrate 0" button and type in the value of the pressure reading seen on the pressure meter.
8. Once completed, select "calibrate 250."
9. Select "OK" and the software will respond by asking "Are you sure?" and then asking for a calibration signature (your initials).
10. After placing your initials in to the dialog box. Select "OK" and the pressure calibration is complete. Cycle power to the unit for the changes in the calibration to take effect.

**END OF SECTION 3.3**

## *3.4 SELF DIAGNOSTIC FAULT CODES*

The following is a list of all possible error codes and there meanings.

**MAIN BOARD/BLOOD PRESSURE ERROR CODES**

| ERROR CODE | DESCRIPTION |
|---|---|
| C02 | Auto-Zero Failure |
| C03 | Inflation Too Rapid |
| C04 | Excessive Inflation Time |
| C05 | Excessive Noise |
| C06 | Outside Measuring Range |
| C12 | Ambient Temperature Out of Range |
| C13 | Battery Failure |
| E10 | Over Pressure Violation |
| E11 | Internal Safety Violation |
| E20 | Missed A/D Sample |
| E30 | ROM Failure |
| E31 | RAM Failure |
| E32 | Factory EEPROM Checksum Failure |
| E33 | User EEPROM Checksum Failure |
| E34 | A/D Converter Failure |
| E35 | SpO2 PCB Failure |
| E36 | Temperature PCB Failure |
| E37 | Printer Failure |
| E38 | Real Time Clock Failure |
| E41 | Stepper Valve Bad |
| E43 | Event Log Erased |

**SpO2 ERROR CODES**

| ERROR CODE | DESCRIPTION |
|---|---|
| E7 | Internal Malfunction |
| C9 | 10 Minute Diagnostic Limit Exceeded |

## TEMPERATURE BOARD ERROR CODES

| ERROR CODE | DESCRIPTION |
|---|---|
| E0.1 | Probe Heater Accumulator |
| E0.2 | Probe A/D Pulse Width Error |
| E0.3 | Adaptive Probe Gain too High or Low |
| Show "A" in Temperature display. Flash Up arrow. | Ambient Temperature too High |
| Show "A" in Temperature display. Flash Down arrow. | Ambient Temperature too Low |
| E0.6 | Host system has violated the interface rules |
| E0.9 | Rcal resistor pulse too long. |
| E1.0 | Rcal resistor pulse too short |
| E1.1 | PTB Resistor above 98.55°F |
| E1.2 | PTB Resistor below 98.15°F |
| E1.4 | Q Only turned heater circuit on |
| E1.5 | C only turned heater circuit on |
| E1.6 | Heater Circuit Error |
| E1.7 | Heater temperature error |
| E1.8 | Heater found on at end of pulse. |
| E9.1 | Communication Error |
| Broken probe icon: | Broken or Missing Probe |
| "P" | Loss of Tissue Contact |
| C22 | 10 Minute Diagnostic Limit Exceeded |

**End of Section 3.4**

## *3.5 COMPLAINT / CAUSE / CORRECTIVE ACTION*

### Troubleshooting: General Guide To Problems And Corrective Actions

QUICK GUIDE TO TAKING A MANUAL (AUSCULTATORY) BLOOD PRESSURE
Action:

1. Collect appropriate equipment.
   Use a certified accurate sphygmomanometer and quality stethoscope.
   Select a blood pressure cuff of a suitable size. Use a blood pressure cuff of the largest appropriate size for patient (see markings on inside of cuff).

2. Have the patient assume a comfortable position with the upper arm relaxed at heart level and the lower arm passively supported.

3. Expose the area of the brachial artery by removing clothing, or move a sleeve, if not too tight, above the area where the cuff will be placed.

4. Center the cuff bladder so that the lower edge is at least 1 inch (2.5cm) above the bend of inner arm of the elbow.

5. Palpate the brachial or radial pulse.

6. Inflate the cuff until the pulsation disappears. Then continue to inflate until the pressure reads 30 mmHg above the point where the pulse disappeared.

7. Listen carefully with stethoscope over brachial artery while controlling the release of air at a rate of 3 mmHg per second.

8. Systolic is determined by reading the manometer gauge when the first faint but clear tapping sound is heard with the stethoscope.

9. Diastolic, in adults, is determined by reading the manometer gauge to the closest even number when the last sound is heard.

10. Release the air quickly after at least 10 to 20 mmHg of silence.

11. Explanation:

a. Many sphygmomanometers are inaccurate. Low quality stethoscopes do not transmit sound well enough for blood pressure sounds to be heard accurately. A cuff that is either too large or too small will produce an inaccurate reading.

b. If the arm is not at the proper level, inaccurate readings will result

c. Clothing over the artery hinders the ability to hear and may cause inaccurate readings. Tight clothing may cause vessel congestion and inaccurate readings.

d. This places the cuff in the best position for occluding the blood flow through the brachial artery.

e. Determines the most accurate location for assessment and approximation of systolic pressure.

f. Facilitates identification of Phase One Korotkoff sounds.

g. One of the major sources of error in auscultatory blood pressure measurement is deflating the cuff too quickly. It is a normal operation of the Welch Allyn Spot Vital Signs to deflate at the American Heart Association recommended 3 mmHg per second.

h. Follows AHA recommended standards.

i. Diastolic blood pressure in children is the point at which the sound becomes muffled.

## SYMPTOM: Inaccurate Blood Pressure Readings

Please note: Differences of up to 10mmHg should be considered normal and will occur for a number of reasons including intra-patient BP variability, observer hearing differences, and auscultatory deflation rate.

| Possible Cause | Explanations and Corrective action |
|---|---|
| Incorrect cuff size.<br>Note: Use Welch Allyn approved cuffs only. | Determine correct cuff size.<br>Use reference markings on cuff<br>Measure patient's arm circumference midway between elbow and shoulder (see "Chart for Determining Cuff Size" on page 24 to select correct cuff size). |
| Patient's arm position. | Ensure patient's arm is at heart level. |
| Arm movement during blood pressure cycle. | Keep arm still during blood pressure cycle.<br>• Movement may cause inaccuracies from artifact. |
| Blood pressure taken over clothing | Blood pressure should be taken on a bare arm. |
| Arrhythmia. | Check for regularity of heart rate.<br>(palpate pulse or check device)<br>• Moderate to severe heart rate irregularities may make blood pressure difficult to measure. |
| Incorrect reference. | Use the correct Korotkoff sound to determine diastolic blood pressure.<br>• Many listeners incorrectly equate diastolic blood pressure with the disappearance of sound only (phase 5). The Welch Allyn Spot Check Device was developed using the American Heart Association recommendations, which state that phase 5 be used unless sound continues to 0 mmHg, in which case the change in the quality of sound (phase 4) is to be used.<br>Deflate cuff no faster than 3 mmHg per second.<br>• One of the major sources of error in auscultatory blood pressure measurement is deflating the cuff too quickly. The American Heart Association recommends deflation no faster than 3 mmHg per second.<br>Only use a sphygmomanometer that is known to be in calibration.<br>• Blood pressure taken with an uncalibrated sphygmomanometer may be very inaccurate. |
| Change in blood pressure from auscultatory reading to Welch Allyn Spot Check Device reading. | Check blood pressure immediately prior to Welch Allyn Spot Check Device Reading. |
| Poor auscultatory sound recognition by observer. | Use higher quality stethoscope. Have a different observer check patient's blood pressure. |

## SYMPTOM: Cuff Inflation & Deflation with No Blood Pressure Reading Dis played (or error code in display)

| Possible Cause | Explanations and Corrective action |
|---|---|
| Leak in pneumatic system. | Ensure all cuff attachments are tight.<br><br>Carefully check for tubing leaks in blood pressure cuff and tubing attached to the device. |
| Arm movement during cycle | Keep arm still during blood pressure cycle<br>• movement may cause inaccuracies from artifact. |
| Tubing movement artifact. | Do not contact tubing during blood pressure cycle<br>• movement may cause inaccuracies from artifact. |

## SYMPTOM: No Cuff inflation.

| Possible Cause | Explanations and Corrective action |
|---|---|
| Connections between device and cuff loose. | Check all connections. (Do not over tighten). |

## SYMPTOM: Temperature Malfunction

| POSSIBLE CAUSE | | EXPLANATION AND CORRECTIVE ACTION |
|---|---|---|
| Error Code Displayed. | Broken probe. | Replace probe.<br>Consult Technical Manual.<br>Notify Biomedical department or Welch Allyn Technical Support.<br>Wait for display window to read OrL, Ally, or Rec (as appropriate) before placing probe. |
| Low Temperature Readings. | Improper probe placement. | Place probe in most posterior sublingual pocket when in Ori mode.<br>Notify Biomedical department or Welch Allyn Technical Support. |
| No Temperature Displayed. | Probe not replaced | Replace probe in holder prior to taking another temperature. |

## SYMPTOM: SpO2 Malfunction

| POSSIBLE CAUSE | | EXPLANATIONS AND CORRECTIVE ACTION |
|---|---|---|
| Sensor in place but No $SpO_2$ on Display. | Improperly attached sensor.<br><br>Cable incorrectly plugged into device. | Insert the patient's finger completely into sensor.<br><br>Ensure sensor cable is correctly plugged into device. |
| Inaccurate $SpO_2$ Reading | Incorrect Sensor | Ensure that correct manufacturers sensor is in use.<br>• Use only Nellcor Puritan Bennett® sensors. |

## SYMPTOM: Printer Malfunction

| Possible Cause | Explanations and Corrective action |
|---|---|
| Paper will not advance | Consult printer Technical Manual.<br><br>Notify Biomedical department or Welch Allyn Technical Support |

## SYMPTOM: Device will not turn on

| Possible Cause | Explanations and Corrective action |
|---|---|
| Low battery | Check connections between device and transformer, and transformer and wall receptacle. |
| Device not powering up. | Unplug unit from wall receptacle and check for breaks in cord. If connections secure, check electrical outlet.<br>• Charging Indicator will be on if connections are OK and the device is plugged into a working outlet.<br>Notify Biomedical Department or Welch Allyn Technical Support |

## SYMPTOM: Cuff Too Tight (Over Inflation)

| Possible Cause | Explanations and Corrective action |
|---|---|
| Pressure Preset too high | Check default Pressure Preset setting: (in Configuration Mode)<br>• Unless patient has underlying systolic hypertension, set pressure preset at 160 mmHg. (If systolic blood pressure greater than pressure preset, the device will automatically increase an additional 40 mmHg) |

## SYMPTOM: Cuff popping off

| POSSIBLE CAUSE | EXPLANATIONS AND CORRECTIVE ACTION |
|---|---|
| Inappropriate cuff size | Determine cuff size with the cuff markings or refer to chart in Operator's Manual for determining cuff size.<br>• If cuff continues to pop off, notify Biomedical Department or Welch Allyn Technical Support. |
| Cuff applied inside out | Re-apply cuff.<br>• Make sure Welch Allyn label is facing away from arm. |

## SYMPTOM: Cuff Deflating Too Slowly.

| Possible Cause | Explanations and Corrective action |
|---|---|
| Normal operation | Typical time to take a reading is 20 to 45 seconds. 165 seconds is the maximum. |

| | |
|---|---|
| Pressure Preset too high | Check default Pressure Preset setting. (In Configuration Mode) |
| Patient movement | Have patient sit still.<br>Do not have arm tight against chest wall as respiration may affect speed and accuracy of blood pressure measurement. |
| Small leak in pneumatic system | Check cuff and tubing for leaks. |

# Section 4 Removal/Replacement of Parts

## *4.1 Battery*

1. Lay unit face down on the test bench
2. Remove the 4 Phillips head screws holding the battery cover/handle to the unit using T112918 with the #4 Phillips bit.
3. Lift handle/cover and aside.
4. Lift battery from housing and disconnect the Molex connector.

***Reassemble in reverse order.***

**End of Section 4.1**

## *4.2 Temperature Pod and Temperature Connector PCB removal*

1. Lay unit face down on the test bench
2. Remove the 4 Phillips head screws holding the battery cover/handle to the unit using T112918 with the #4 Phillips bit (T112919).
3. Lift handle/cover and aside.
4. Lift battery from housing and disconnect the Molex connector.
5. Remove 3 #10 Torx Screws from the temperature pod using T112917 with the #10 Torx bit (T114030).
6. Roll temperature pod toward top of the unit and place on test bench.
7. Unplug the flex cable from the temperature connector PCB and aside the temperature pod.
8. Remove the #10 Torx screws from the temperature connector PCB using T112917 with the #10 Torx bit (T114030). Aside the temperature connector PCB.
9. Remove the temperature probe housing by removing the two #10 Torx screws using T112917 with the #10 Torx bit (T114030). Aside housing.

***Reassemble in reverse order***

**End of section 4.2**

## *4.3 Front Housing and Switch Array*

1. Lay unit face down on the test bench
2. Remove the 4 Phillips head screws holding the battery cover/handle to the unit using T112918 with the #4 Phillips bit (T112919).
3. Lift handle/cover and aside.
4. Lift battery from housing and disconnect the Molex connector.
5. Remove 3 #10 Torx Screws from the temperature pod using T112917 with the #10 Torx bit (T114030).
6. Roll temperature pod toward top of the unit and place on test bench.
7. Unplug the flex cable from the temperature connector PCB and aside the temperature pod.
8. Remove the 4 Phillips head screws using T112918 with the #4 Phillips bit (T112919).
9. If equipped with SpO2, remove and aside the SpO2 cable clip.
10. Remove the tubing from the front housing.
11. Remove the switch array from the front housing. Aside Front Housing.

***Reassemble in reverse order***

**End of Section 4.3**

## *4.4 Display PCB*

1. Lay unit face down on the test bench
2. Remove the 4 Phillips head screws holding the battery cover/handle to the unit using T112918 with the #4 Phillips bit (T112919).
3. Lift handle/cover and aside.
4. Lift battery from housing and disconnect the Molex connector.
5. Remove 3 #10 Torx Screws from the temperature pod using T112917 with the #10 Torx bit (T114030).
6. Roll temperature pod toward top of the unit and place on test bench.
7. Unplug the flex cable from the temperature connector PCB and aside the temperature pod.
8. Remove the 4 Phillips head screws using T112918 with the #4 Phillips bit (T112919).
9. If equipped with SpO2, remove and aside the SpO2 cable clip.
10. Remove the tubing from the front housing and aside housing.
11. Gently lift the LCD module from its post.
12. Roll the LCD to the left and set on the bench beside the Spot unit.
13. Remove the flex cable from the LCD and aside the display.

***Reassemble in reverse order***

**End of Section 4.4**

## *4.5 Remove Power and Battery Cable*

1. Lay unit face down on the test bench
2. Remove the 4 Phillips head screws holding the battery cover/handle to the unit using T112918 with the #4 Phillips bit (T112919).
3. Lift handle/cover and aside.
4. Lift battery from housing and disconnect the Molex connector.
5. Remove 3 #10 Torx Screws from the temperature pod using T112917 with the #10 Torx bit (T114030).
6. Roll temperature pod toward top of the unit and place on test bench.
7. Unplug the flex cable from the temperature connector PCB and aside the temperature pod.
8. Remove the 4 Phillips head screws using T112918 with the #4 Phillips bit (T112919).
9. If equipped with SpO2, remove and aside the SpO2 cable clip.
10. Remove the tubing from the front housing and aside housing.
11. Gently lift the LCD module from its post.
12. Roll the LCD to the left and set on the bench beside the Spot unit.
13. Remove the flex cable from the LCD and aside the display.
14. Disconnect the power cable from the main PCB by pushing down on the tab and pulling toward the bottom of the unit.
15. Lift ferrite from it holder.
16. Using a T114135 3/8" Hex socket attached to T112918A, remove the nut from the transformer connector and slide the cable through the rear housing opening.
17. Slide the battery connector out of the rear housing and aside the cable assembly.

***Reassemble in reverse order***

**End of Section 4.5**

## *4.6 Main PCB Removal*

1. Lay unit face down on the test bench
2. Remove the 4 Phillips head screws holding the battery cover/handle to the unit using T112918 with the #4 Phillips bit (T112919).
3. Lift handle/cover and aside.
4. Lift battery from housing and disconnect the Molex connector.
5. Remove 3 #10 Torx Screws from the temperature pod using T112917 with the #10 Torx bit (T114030).
6. Roll temperature pod toward top of the unit and place on test bench.
7. Unplug the flex cable from the temperature connector PCB and aside the temperature pod.
8. Remove the 4 Phillips head screws using T112918 with the #4 Phillips bit (T112919).
9. If equipped with SpO2, remove and aside the SpO2 cable clip.
10. Remove the tubing from the front housing and aside housing.
11. Gently lift the LCD module from its post.
12. Roll the LCD to the left and set on the bench beside the Spot unit.
13. Remove the flex cable from the LCD and aside the display.
14. Disconnect the power cable from the main PCB by pushing down on the tab and pulling toward the bottom of the unit.
15. Remove the pneumatic tubing from the transducer on the PCB.
16. Remove the battery/Valve cable connector from the bottom of the PCB.
17. Remove the 4 #10 Torx screws from the PCB using T112917 with the #10 Torx bit.
18. Lift Main PCB from housing and aside.
19. If unit has SpO2, remove the SpO2 Module from defective Main PCB and add to new Main PCB.

***Reassemble in reverse order***

**End of Section 4.6**

## *4.7 SpO2 PCB Removal (If configured with SpO2)*

1. Lay unit face down on the test bench
2. Remove the 4 Phillips head screws holding the battery cover/handle to the unit using T112918 with the #4 Phillips bit (T112919).
3. Lift handle/cover and aside.
4. Lift battery from housing and disconnect the Molex connector.
5. Remove 3 #10 Torx Screws from the temperature pod using T112917 with the #10 Torx bit (T114030).
6. Roll temperature pod toward top of the unit and place on test bench.
7. Unplug the flex cable from the temperature connector PCB and aside the temperature pod.
8. Remove the 4 Phillips head screws using T112918 with the #4 Phillips bit (T112919).
9. If equipped with SpO2, remove and aside the SpO2 cable clip.
10. Remove the tubing from the front housing and aside housing.
11. Gently lift the LCD module from its post.
12. Roll the LCD to the left and set on the bench beside the Spot unit.
13. Remove the flex cable from the LCD and aside the display.
14. Disconnect the power cable from the main PCB by pushing down on the tab and pulling toward the bottom of the unit.
15. Remove the pneumatic tubing from the transducer on the PCB.
16. Remove the battery/Valve cable connector from the bottom of the PCB.
17. Remove the 4 #10 Torx screws from the PCB using T112917 with the #10 Torx bit.
18. Lift Main PCB from housing and aside.
19. Remove the 3 Phillips head screws along with the nuts and spacers form the SpO2 PCB. Use T112918 with the Phillips bit (T112919) and needle nose pliers.
20. Remove the SpO2 module (Nellcor MP205) from the main PCB and aside.

**Note:** ***Remember to ensure that they are two shunts at the top of the jumper row on the Nellcor MP205 PCB Before you install onto the Main PCB. Further, ensure that the two locking tabs on the connectors of the Nellcor MP205 PCB are broken off before installing onto the Main PCB. Ensure, also, that the nylon washers are located on the main PCB when reassembling the SpO2 PCB to the Main PCB.***

***Reassemble in reverse order***

**End of Section 4.7**

## *4.8 Pump and Valve Removal*

1. Lay unit face down on the test bench
2. Remove the 4 Phillips head screws holding the battery cover/handle to the unit using T112918 with the #4 Phillips bit (T112919).
3. Lift handle/cover and aside.
4. Lift battery from housing and disconnect the Molex connector.
5. Remove 3 #10 Torx Screws from the temperature pod using T112917 with the #10 Torx bit (T114030).
6. Roll temperature pod toward top of the unit and place on test bench.
7. Unplug the flex cable from the temperature connector PCB and aside the temperature pod.
8. Remove the 4 Phillips head screws using T112918 with the #4 Phillips bit (T112919).
9. If equipped with SpO2, remove and aside the SpO2 cable clip.
10. Remove the tubing from the front housing and aside housing.
11. Gently lift the LCD module from its post.
12. Roll the LCD to the left and set on the bench beside the Spot unit.
13. Remove the flex cable from the LCD and aside the display.
14. Disconnect the power cable from the main PCB by pushing down on the tab and pulling toward the bottom of the unit.
15. Remove the pneumatic tubing from the transducer on the PCB.
16. Remove the battery/Valve cable connector from the bottom of the PCB.
17. Remove the 4 #10 Torx screws from the PCB using T112917 with the #10 Torx bit.
18. Lift Main PCB from housing and aside.
19. Remove the pneumatic tubing from the valve and the pump.
20. Remove the valve and the pump from their respected location on the rear housings and aside

***Reassemble in reverse order***

**End of Section 4.8**

# Section 5 Test Procedures

## *Section 5.1 Calibration Tests*

**ABSTRACT:** The following are the test procedures for the Spot Vital Signs. We set this procedure up so that you can start at section 5.1 and go straight through the procedure or you can skip around. However, you must do all of the test called out in this section before a unit can be returned to field service.

**NOTES**:
A. The word "unit" in this text refers to the Spot Vital Signs.
B. "***Menu|Choice"*** represents menu commands. Rather than use the phrase "choose the Exit command from the File menu."

1. Connect the unit to the test station by hooking up the pneumatic tubing, removing the battery and connecting the power supply. Ensure that there are no obstacles in the way of the IR window.
2. Place the unit into the "configuration test mode" by holding down the start button while powering up the unit. Allow the software versions to be displayed then press the mode button until the unit displays "CAL" in the LCD window. The unit will automatically perform a auto zero once "CAL" is displayed.
3. Attach a pneumatic clamp to the 100cc and the 250cc volume, remove the clamp from the 500cc volume.
4. Select ***Test|Calibration***. The dialog box will display the unit manometer reading, unit battery reading, valve and pump status.
5. Use Start button to close valve of the unit, and hand bulb to set the pressures.
6. Verify that the unit is within calibration specification at all the following target pressures: 0, 50, 175, 275 mmHg. All target pressures have a tolerance of +/- 5 mmHg. Specification are found in the Repair Test Specifications document.
7. Press the "mode" button until the LCD window reads "bat."
8. Set the power supply to 5.5 + 0.2/- 0 Vdc (5.5 to 5.7 Vdc). Verify that the voltage reading of the unit meets specification called out in the Repair Test Specification document. Return the power supply to 6.5 Vdc upon completion of this test.
9. Select "OK" to exit from the "Test Calibration" dialog box.

**End of Section 5.1**

## *Section 5.2 Current Tests*

1. Connect the unit to the test station by hooking up the pneumatic tubing, removing the battery and connecting the power supply. Ensure that there are no obstacles in the way of the IR window.
2. Power down unit then re-power unit allowing the unit to boot up into its normal mode.
3. Select ***Test\Current Levels***. Check the following current levels:
   a) Blank
   b) Back Light
   c) Valve/Pump
   d) SpO2 Mode
4. Verify these currents meet the specifications called out in the Repair Test Specification document.
5. Select "OK" to exit dialog box.

**End of Section 5.2**

## *Section 5.3 Noise Levels*

1. Connect the unit to the test station by hooking up the pneumatic tubing, removing the battery and connecting the power supply. Ensure that there are no obstacles in the way of the IR window.
2. Click on ***Test\Noise Levels***.
3. Press Test button to retrieve the units internal pressure channel noise level. Verify that the noise level meets the specification called out in the Repair Test Specification document.
4. Select "OK" to exit dialog box.

**End of Section 5.3**

## *Section 5.4 Button Test*

1. Connect the unit to the test station by hooking up the pneumatic tubing, removing the battery and connecting the power supply. Ensure that there are no obstacles in the way of the IR window.
2. Choose ***Test\Button Test***. Press each button and ensure that the computer acknowledges it, via the "Button Pressed" display.
3. Select "OK" to exit from dialog box.

**END OF SECTION 5.4**

## *Section 5.5 Interface Test*

1. Connect the unit to the test station by hooking up the pneumatic tubing, removing the battery and connecting the power supply. Ensure that there are no obstacles in the way of the IR window.
2. Select *Test\Display* in the repair software.
3. Select "all on" in the LCD Display section and ensure that all the segments are lit on the unit.
4. Select "all off" in the LCD Display section and ensure that all the segments are not lit on the unit.
5. Select "normal" in the LCD Display section to return the display to normal.
6. Select "on" in the Back-light section and ensure light comes on.
7. Select "off" in the Back-light section and ensure light goes off.
8. Select the buzzer test and ensure that the buzzer of the Spot Device is "on." Select "OK" to exit test and turn off the buzzer.
9. Select "OK" to exit dialog box.

**End of Section 5.5**

## *Section 5.6 Print Quality*

1. Connect the unit to the test station by hooking up the pneumatic tubing, removing the battery and connecting the power supply. Ensure that there are no obstacles in the way of the IR window.
2. Ensure that you have the HP IR printer that work with the Spot Vital Signs.
3. Choose ***Test\Print Quality***. Choose "test pattern 1." The printer will print out a pattern of large and small ASCII characters. Verify the quality of the printer output. Once test 1 is complete, choose test pattern 2. The printer will print out a solid gray field. Verify the quality of the printer output.
4. Select "OK" to close the box.

***Note:* This test can only be completed if using the TTL service port. This test can not be completed if the tester is using IR for communication. Further, if print quality is poor, change out the AA batteries of the printer and re-test.**

**End of Section 5.6**

## *Section 5.7 Pneumatic Tests*

1. Connect the unit to the test station by hooking up the pneumatic tubing, removing the battery and connecting the power supply. Ensure that there are no obstacles in the way of the IR window.
2. Select ***Test\Pneumatic***, and then the "Leak Test" option. The software will test for leak and will give you a Pass or Fail indication.
3. Select the "Dump Test" option. The software will automatically test for the dump speed and will give you a Pass or Fail indication.
4. Select the "Inflation Test" option. The software will automatically test for the inflation time and give you a Pass or Fail indication.
5. Select "Valve Control Test" option. The software will automatically test to ensure that the unit can control the valve and ensure that the valve is good.
6. Select "OK" to exit the dialog box.

**End of Section 5.7**

## *Section 5.8 SpO2 Tests*

1. Connect the Nellcor SpO2 simulator (SRC2) to the unit with the test cable.
2. Ensure that the following are the settings of the simulator:
    a) Rate: 112
    b) Light: High 1
    c) Modulation: High
    d) RCAL Mode: RCAL63/Local
3. Verify the reading of the unit meets requirements when compared to the Repair Test Specification.
4. Reconnect the SpO2 sensor. Place the sensor onto your finger. The unit should return a reading if the sensor is OK.

**End of Section 5.8**

## *Section 5.9 Temperature Tests*

1. Disconnect the temperature probe from the unit leaving the probe itself in its housing. Place the "CAL key" into the connector. Remove the probe from the housing. The temperature should read 97.3 F +/- .2 F. Remove the "cal" key and reconnect the probe.
2. Make sure that the unit's temperature option is in the "monitor mode". Do this by removing the probe from the housing and observing the temperature display. "Monitor mode" should be seen in the lower right hand side of the display. If this is not seen, wait approximately 30 - 45 seconds and the unit will change mode to the "monitor mode."
3. Set up the Diatek 9600 calibrator. Set the calibrator to 96.4 F or use a water bath between 84 F and 106 F. Allow the calibrator to stabilize for three (3) minutes. Place the probe into the small hole in the calibrator. Observe the temperature display, The reading should be 96.4 F +/- .3 F within 30 - 45 seconds.
4. Place the probe back into the housing. Set the calibrator to 106 F. Allow the calibrator to stabilize for three minutes. Remove the probe from the housing, the unit must be in the monitor mode, if not wait until the unit is in that mode. Place probe into the small hole at the top of the calibrator. The reading should be 106 F +/- .3 F within 30 - 45 seconds. If using a water bath skip this part of the test.

**End of Section 5.9**

## *Section 5.10 Fail Safe Testing*

1. Connect the unit to the test station by hooking up the pneumatic tubing, removing the battery and connecting the power supply. Ensure that there are no obstacles in the way of the IR window.
2. Place the unit into the "configuration test mode" by holding down the start button while powering up the unit. Allow the software versions to be displayed then press the mode button until the unit displays "CAL" in the LCD window.
3. Ensure that the unit is connected to the 500cc volume.
4. Press the "start" button to close the valve.
5. Increase pressure on the unit until E10 appears in the LCD screen. Record the highest pressure observed on the pressure meter.
6. Press the "cancel" button to return the unit to "CAL" mode.
7. Press the "start" button to close the valve.
8. Apply 70 mmHg to the unit and start a timer.
9. When the unit returns a E11, stop the timer and record the time.

**End of Section 5.10**

## *Section 5.11 Check List For Spot Vital Signs Service Work*

**General Data**

| Repair Number | Date | Tech | Unit SN | Life Cycle Count | Model |
|---|---|---|---|---|---|
| | | | | | |

**Repair Data:**

**Check all items repaired/replaced and record serial # where possible:**

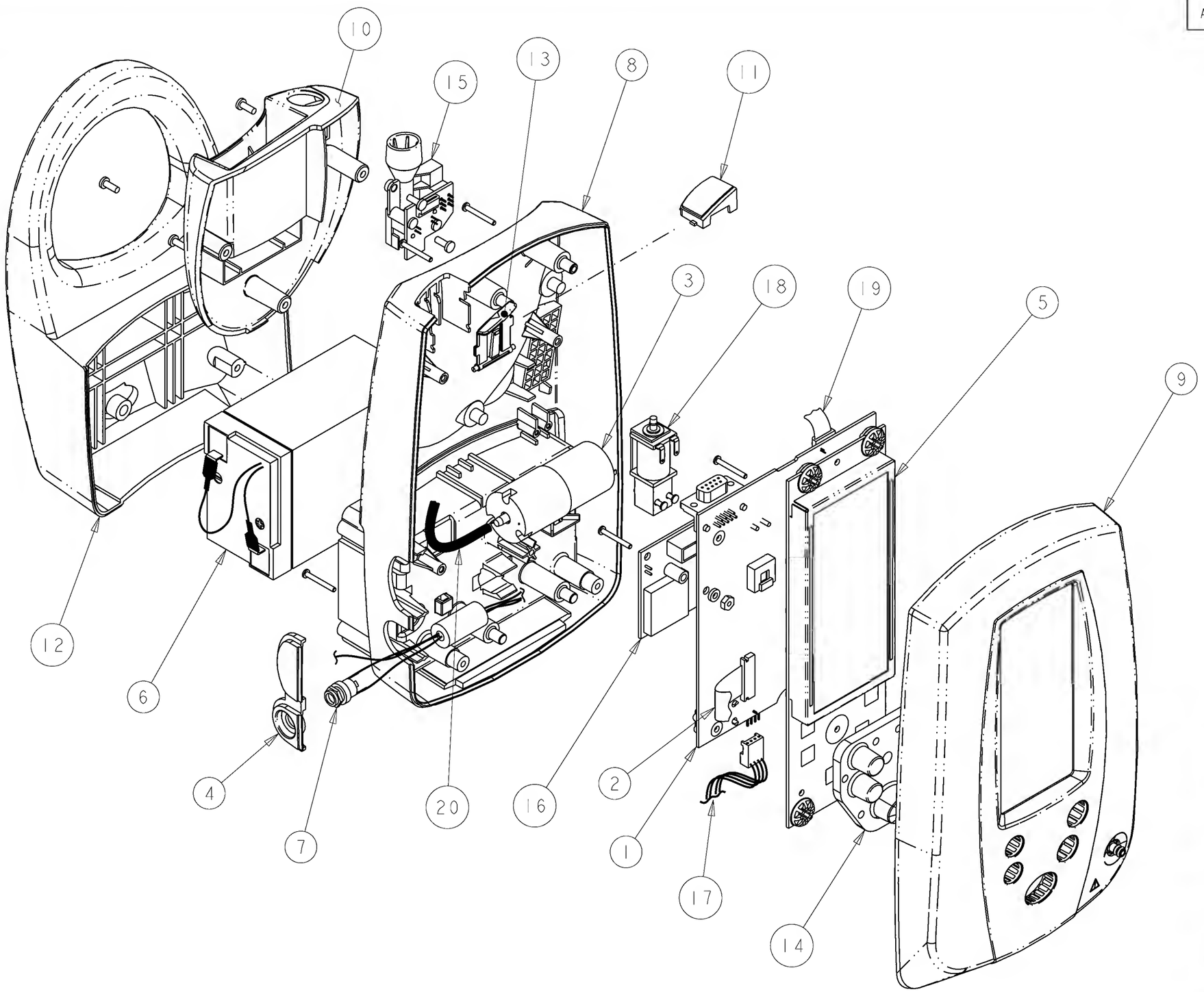
| Items | Repair or Replaced | Serial Number or Lot Number |
|---|---|---|
| Main PCB | | |
| Display PCB | | |
| Temp. Connector PCB | | |
| SpO2 PCB | | |
| Valve | | |
| Pump | | |
| Pneumatic Tubing | | |
| Power Harness | | |
| Pump and Valve Wire Harness | | |
| Battery | | |
| Front Housing | | |
| Rear Housing | | |
| Temperature Pod | | |
| Temperature Probe | | |
| SpO2 Sensor | | |

| Test Information | Test Data | Test Specifications |
|---|---|---|
| Unit SW Version | | |
| SpO2 SW Version | | |
| Test Pressure @ 275 mmHg | | +/- 5 mmHg |
| Unit pressure @ 275 mmHg | | +/- 3 mmHg |
| Test Pressure @ 175 mmHg | | +/- 5 mmHg |
| Unit Pressure @ 175 mmHg | | +/- 3 mmHg |
| Test Pressure @ 50 mmHg | | +/- 5 mmHg |
| Unit Pressure @ 50 mmHg | | +/- 3 mmHg |
| Test Pressure @ 0 mmHg | | +/- 1 mmHg |
| Test Pressure @ 0 mmHg | | +/- 1 mmHg |
| Test Voltage | | 6.0 + 0/-0.2 Vdc |
| Unit Voltage | | +/- 0.05 Vdc |
| Blank Current | | <= 200 mA |
| Back Light Current | | <= 400 mA |
| Valve/Pump Current | | <= 700 mA |
| SpO2 Current | | <= 120 mA |
| Noise Level | | <= 0.05 mmHg |
| Button Test | | Pass/Fail |
| Interface Test | | Pass/Fail |
| Print Quality (If applicable) | | Pass/Fail |
| Unit Leak | | <= 5 mmHg in 15 seconds. |
| Unit Dump Time | | <= 10 seconds |
| Unit Inflation Time | | <= 7 seconds |
| Valve Control Test | | Pass/Fail |
| Over Pressure Test | | 296 mmHg to 329 mmHg |
| Over 15 mmHg Test | | <= 180 seconds |
| SpO2 Simulator Reading | | 81% +/- 3%; 112 BPM +/- 3 BPM |
| SpO2 sensor Reading | | Pass/Fail |
| Temperature Calibration Reading (96.4 F)) | | 96.4F+/-0.3F (35.8C+/-0.2C) |
| Temperature Calibration Reading (106 F) | | 106F+/-0.3F (41C+/-0.2C) |
| Temperature Cal Key Reading | | 97.3F+/-0.2F (36.3C+/-0.1C) |

# Section 6 Drawings

- **6.1....Exploded view of Spot Vital Signs**
- **6.2....Electrical schematics**

| REV | DESCRIPTION | ECN/ECO | INIT | DATE | CKD |
|---|---|---|---|---|---|
| A | RELEASE TO PROD. ENG. | AMT41550-36 | TJW | 1/7/01 | |




SEE REPAIR PARTS LIST IN SECTION 2 OF THE SPOT SERVICE MANUAL (95P506E) FOR DESCRIPTIONS

| - | - |
|---|---|
| PART NO. | DESCRIPTION |

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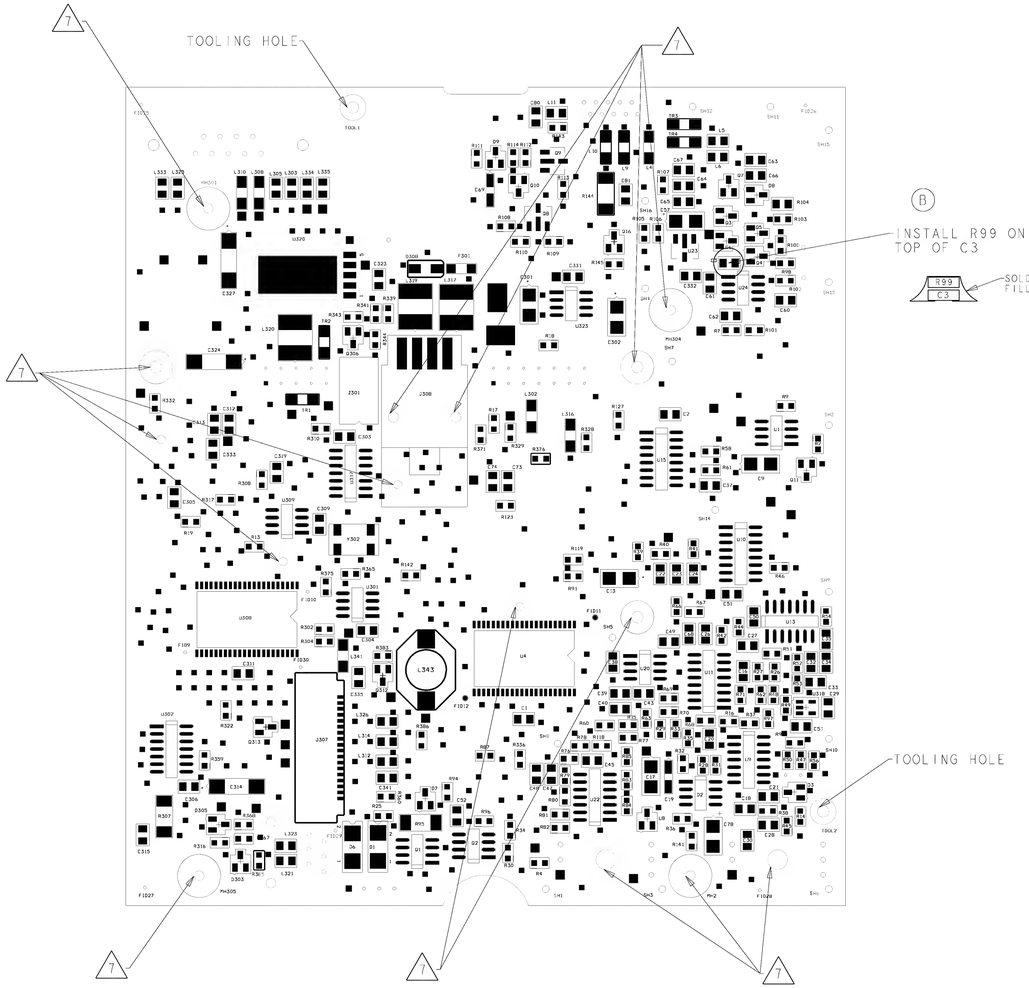
| | | |
|---|---|---|
| DRAWN: TJW | DATE: 01-Feb-01 | Welch Allyn® |
| APPROVED: - | DATE: - | MATERIAL: - |
| REL TO PROD: - | DATE: - | FINISH: - |
| - | - | TITLE: SERVICE REPAIR PARTS |
| CAD SOFTWARE: | ProE | |
| TRANSLATED FROM: | | |

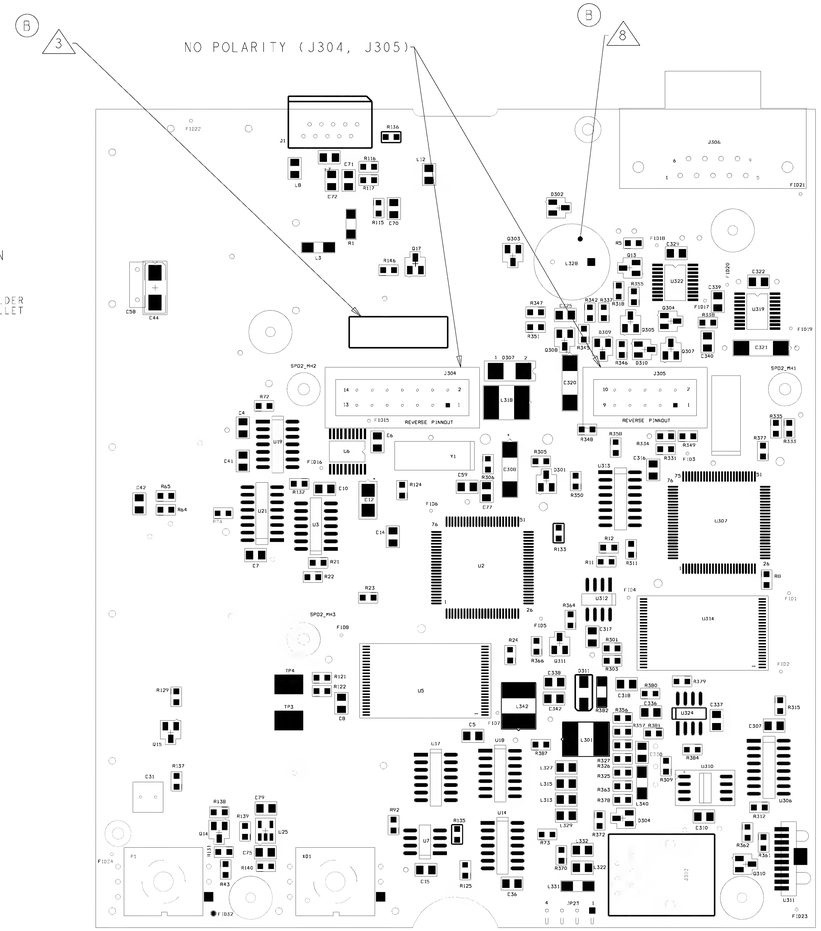
UNLESS OTHERWISE SPECIFIED
TOLERANCES DIMENSIONS ARE IN INCHES
.XX = ±.02
.XXX = ±.005
ANGLES ±2°

| SIZE | DRAWING NO. | REV |
|---|---|---|
| B | 421216 | A |
| SCALE 0.500 | SHEET 1 of 1 | |

| REV | DESCRIPTION | ECN/ECO | INIT | DATE | CKD |
|---|---|---|---|---|---|
| A | RELEASE TO PROD. ENG. | AMT41550-3 | JRS | 9/5/00 | T.W. |
| B | CHG S/N LABEL LOCATION; ADD NOTE 8; ADD P/N: -502, ADD "INSTALL R99 ON TOP..." | AMT41550-37 | ASK | 2/28/01 | - |




TOP SIDE




BOTTOM SIDE

NOTES:

1. ASSEMBLY TO CONFORM TO THE LATEST REVISION OF IPC-A-610 CLASS 2 STANDARDS FOR ELECTRONIC ASSEMBLIES, UNLESS OTHERWISE SPECIFIED. REWORK IS ACCEPTABLE IF IT CONFORMS TO THE LATEST REVISION OF IPC-R-700C.
2. SEE BOM FOR COMPONENT POPULATION INFORMATION.
3. COMPLETE PCB ASSEMBLY TO BE LABELED WITH:
   - WELCH ALLYN ASSEMBLY PART NUMBER
   - REVISION LEVEL
   - DATE CODE (WEEK YEAR EG 2200)
   - SERIAL NUMBER (5 DIGITS MIN.)
4. PACKAGING TO BE APPROVED BY WELCH ALLYN. HANDLING AND PACKAGING TO PREVENT DAMAGE DUE TO ESD, BENDING, ETC.
5. ALL PCB ASSEMBLIES SHALL BE TESTED PER THE TEST SPECIFICATION. A TEST MARKING SHALL BE PROVIDED WITH EACH ASSEMBLY AFTER A SUCCESSFUL COMPLETION.
6. LOCALIZED CLEANING IF NECCESSARY.
7. NO SOLDER THESE HOLES.
8. REMOVE LABEL FROM BEEPER

| | |
|---|---|
| THIS DWG -502 | ADD R99 ON TOP OF C3 |
| THIS DWG -501 | - |
| PART NO. | DESCRIPTION |

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| | | |
|---|---|---|
| DRAWN: J. STROM | DATE 07-Sep-00 | Welch Allyn® |
| APPROVED T. WAWRO | DATE 9/26/00 | MATERIAL: - |
| REL TO PROD J. HOWARD | DATE 9/26/00 | FINISH: - |
| T. EDMONDSON | 9/26/00 | TITLE: ASSY, SPOT MAIN PCB |
| CAD SOFTWARE: | PRO-E | |
| TRANSLATED FROM: | DXF | |

UNLESS OTHERWISE SPECIFIED TOLERANCES DIMENSIONS ARE IN INCHES
.XX = ±.02
.XXX = ±.005
ANGLES ±2°

| | | |
|---|---|---|
| D | DRAWING NO. 421100 | REV B |
| | SCALE 2:1 | SHEET 1 of 1 |

| REV | DESCRIPTION | ECN | INIT | DATE | APPROVAL |
|---|---|---|---|---|---|
| A | RELEASE TO PRODUCTION | AMT41550-3 | WNC | 09-27-00 | KNUT SPANG |
| B | CHANGE C57 TO 1uF<br>ADD R99 | AMT51550-25 | | 12-19-00 | |

# Failsafes and Optional Populations

GNDD GNDD

THIS MESS TIES GNDS TOGETHER, MUST BE AT TOP LEFT QN EVERY PAGE. THANKS QRCAD

15mm

330mm

PTRANS

GT_15MM

LT_15MM

LT_330MM

C1RC R58 1M C1P1

C1QSC1 R61 162K

C1QSC2 C37 0.01uF

U15 14060B

C1QUT

C8 .047uF

C36 .047uF

C59 .047uF

C1 .047uF

U18A 4013

C1_QK

U14A 74HC02 /INFLAT

U14B 74HC02

INFLAT_QK

R125 1M

INFLATE_FAIL

U17A 74HC00

U17B 74HC00

R74 1K

QVP_FAIL

U14C 74HC02 /FAIL1

U17D 74HC00 FAIL

U17C 74HC00 /FAIL

/FAIL

/FAIL2

LQNG_FAIL

U14D 74HC02

R123 1M

C2 .047uF

U19A 74HC74

FCLR

R124 1M

C7 .047uF

U21 14060B

LT_15MM_TEST

C2RC R64 1M C2P1

C2QSC1 R65 261K

C2QSC2 C42 0.033uF

C2QUT

U18B 4013

U18_TEST

R73 1K

U19B 74HC74

WD_FAIL

/RES

U19_CLR_TEST

R72 1K

R127 1M

C38 100pF 15MM_QUT

R62 100K 15MM_IN

15MM_REF R63 100K C39 .047uF

U20A LM393

C49 .047uF

C40 100pF

R60 1K

R66 1K R67 10K

30MM_QUT

R68 887 30MM

R69 100K 300MM_REF

R70 13.3K C43 .047uF

U20B LM393

C68 100pF

30MM_IN R71 100K

PRQBE_SW

/PRQBE_LED_QN

R145 100K

Q16 IRLML6402

R143 10K

PRQBE_SW PAT_PRQBE_SW

C80 0.01uF

PRQBE_LED_QN

TEMP_POD_SENSE

PRB_LED_2 PRB_LED_QN

R144 82

C81 0.01uF

POD_SENSE

PRQBE_1 PRQBE_0

R146 1K /POD_SENSE

Q17 MMBT3904

R116 1M R117 1M

C71 0.01uF C72 0.01uF

TEMPERATURE POD

PAT_RES PAT_PRBD PRBHT PAT_PRQBE_0 PAT_PROBE_1 PRBSWGND TEMP_POD_SENSE PRQBE_LED_QN PAT_PRQBE_SW

PRBGND

J1

L5 L6 L7 L8 L9 L4 L10 L12

TR3 14V 0.4j TR4 14V 0.4j

PROBE CONNECTOR PCA

PROBE THERMISTOR J1-A1 J1-B1

+5V

R108 1K /HTRQ HTB1 Q8 BCX69

HTAMP

R109 46.4K HTRQS

R110 46.4K HTRPWR

R111 3 MEG

D9 MMBD1203

R112 1K HTB2 Q9 BCX69

HTE0

R114 1K

R113 46.4K

/HTRC HTB0 Q10 MMBT5087

HTRC2

R1 2.7 PRBHTR L3 PRBHT

R115 4.64K C70 0.01uF

C69 1uF

160mA 160^2 * 2.7 = 71mW

PROBE WARMER

# Temperature Hardware 678

TEMPERATURE A/D CONVERTER

U23 RH5RE24AA-T1 +5VA VIN NC VOUT VREFTEMP

C332 .047uF C57 1uF

AD_TRIGGER

R98 4.64K ADB1 Q4 MMBT5087

C58 0.33uF PQLY AD_DC 2

C44 0.33uF Tantalum

R100 10K ADB2 Q5 MMBT2222A

R99 1K C3 0.01uF

U24 TLC555CD

C61 0.01uF CTRL TRG THR DSCH QUT

AD_DSCH

R7 4.64K R101 1K AD_QUT

C62 100pF

C60 1000PF

R102 1K

C63 0.01uF RES

R103 12.1K

R104 11.55K 0.05%

CALD

PRBD

D8 MMBD1203

Q3 BSS138 RCAL_F

R105 1K RCAL_SEL

C64 100pF

Q6 BSS138 PTBCAL_F

R106 1K PTBCAL_SEL

C65 100pF

C66 0.01uF

Q7 BSS138 PRBSEL_F

R107 1K PRQBE_SEL

C67 100pF

This cap not populated in 678

WELCH ALLYN PROBE CONNECTIONS

J1-A2 PROBE HEATER RESISTOR J1-B2

CUT HERE FOR RECTAL

J1-B3 J1-A3

CUT HERE FOR CAL KEY

| | PRQBE_0 | PRQBE_1 |
|---|---|---|
| QRL | 0 | 0 |
| REC | 0 | 1 |
| CAL | 1 | 0 |
| NQ PRQBE | 1 | 1 |

PRBD PIN1 (B1)
PIN 2 (B2) GND
PRQBE_1 PIN 3 (B3)

B1 B2 B3 A1 A2 A3

RES PIN 6 (A1)
PRBNT PINS (A2)
PRQBE_0 PIN 4 (A3)

PROBE CONNECTOR (TOP VIEW)

Secondary XDCR

+5VA C45 .047uF

U22A NE5234 +1VAS XDPWR XD1

C47 1000PF

XD_FB FPNS-07PGR

R82 1.96K

C48 1000PF

U22C NE5234 XD+ IAI+ IAFB+ R79 133K R80 10K

R76 10K IAQ+ R77 68.1K R78 68.1K +2VA

U22B NE5234

U22D NE5234 IAFB- R81 133K IAI- XD-

R84 10K IAQ- R83 68.1K R85 68.1K

STRANS

R118 100K

# FAILSAFES / TEMPERATURE

| REV | REVISION DESCRIPTION | ECN | INIT | DATE | APPRV |
|---|---|---|---|---|---|

DRAWN WILL CUIPYLQ DATE 09-06-00

APPROVED KNUT SPANG DATE 09-06-00

REL TO PRODUCTION <REL TO PRODUCTION> DATE 09-27-00

Welch Allyn

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TITLE SPQT CHECK MAIN PCB

Copyright Wednesday, February 28, 2001

Size D DWG NO 421102 Sheet 1 of 3 Rev B

# MOD B

| REV | DESCRIPTION | ECN | INIT | DATE | APPROVAL |
|---|---|---|---|---|---|
| A | RELEASE TO PRODUCTION | AMT41550-3 | WNC | 09-27-00 | KNUT SPANG |
| | CHANGE C57 TO 1uF | | | | |
| B | ADD R99 | AMT51550-25 | | 12-19-00 | |
| | | | | | |

## ANALOG VOLTAGE REGULATOR

U1 TPS7250Q

THIS MESS TIES GNDS TOGETHER. MUST BE AT TOP LEFT ON EVERY PAGE. THANKS ORCAD

## DIGITAL VOLTAGE REGULATOR

U6 TPS7350QPWR

Q11 MMBT3904

## Micro

U2 H8/3042

## Flash

U5 AM29F400BB-70EC TSOP48

## RAM

U4 IDT71016

## Address Decoding

U3A 74HC08 · U3B 74HC08 · U3C 74HC08 · U3D 74HC08

## EEPROM

U7 93C56

## PUMP / VALVE DRIVE

D6 MRA4003T3 · D1 MRA4003T3 · D7 MMBD1503A · Q1B SI9945DY · Q1A SI9945DY · Q2A SI9945DY · Q2B SI9945DY

REPLACE CS2 WITH 0 OHM JUMPER FOR PNEUTRONICS VALVE

## Analog Reference

U25 OPA353NA · D2 LM385M

## MAIN

## Batt Sense

## Temp

LM50B

## Primary XDCR

Primary Transducer

0mmHG = 0.5V
300mmHG = 4.0V

P1 XFPM-050KPG-P1

## Op-Amp and DC Offset

Zero Adjust +/-20mmHg range

## Offset

PWM D/A 64.0KHz

T1OCA0 Hitachi pin 95

## Shield

## MUX

U10 · U11 4051 · MC74HC174A

## Integrator

PWM A/D Converter

## Module B PWM A/D Converter

## Comparator

U318 OPA353NA

| REV | DESCRIPTION | ECN | INIT | DATE | APPROVAL |
|---|---|---|---|---|---|
| A | RELEASE TO PRODUCTION | AMT41550-3 | WNC | 09-27-00 | KNUT SPANG |
| B | CHANGE C57 TO 1uF<br>ADD R89 | AMT51550-25 | | 12-19-00 | |

THIS MESS TIES GNDS TOGETHER. MUST BE AT TOP LEFT ON EVERY PAGE. THANKS ORCAD

SPOT MAIN SECTION

SPOT POWER SECTION

SPOT I/O SECTION

SPOT MOUNTING HOLES

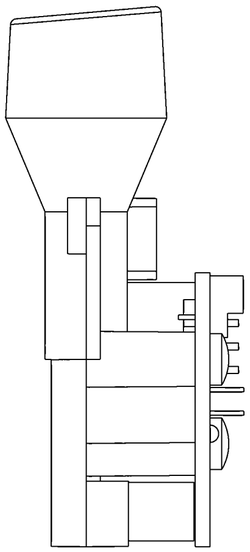
SPOT

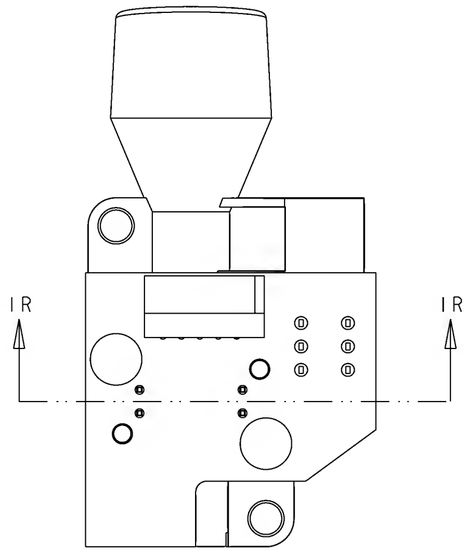
| REV | REVISION DESCRIPTION | ECN | INIT | DATE | APPRV |
|---|---|---|---|---|---|
| | | | | | |

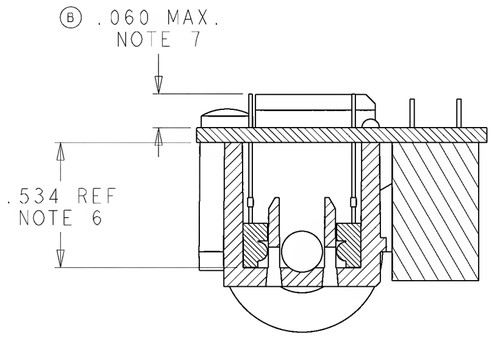
Copyright Thursday, December 28, 2000

| | | |
|---|---|---|
| DRAWN WILL CUIPYLO | DATE 09-06-00 | **Welch Allyn** |
| APPROVED KNUT SPANG | DATE 09-06-00 | THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF WELCH ALLYN, INC. AND SHALL NOT BE REPRODUCED, OR COPIED, OR USED AS A BASIS FOR SALE OR MANUFACTURE OF EQUIPMENT OR DEVICES WITHOUT WRITTEN PERMISSION. |
| REL TO PRODUCTION <REL TO PRODUCTION> | DATE 09-27-00 | TITLE SPOT CHECK MAIN PCB |
| | Size D | DWG NO 421102 |
| | Sheet 3 of 3 | Rev B |

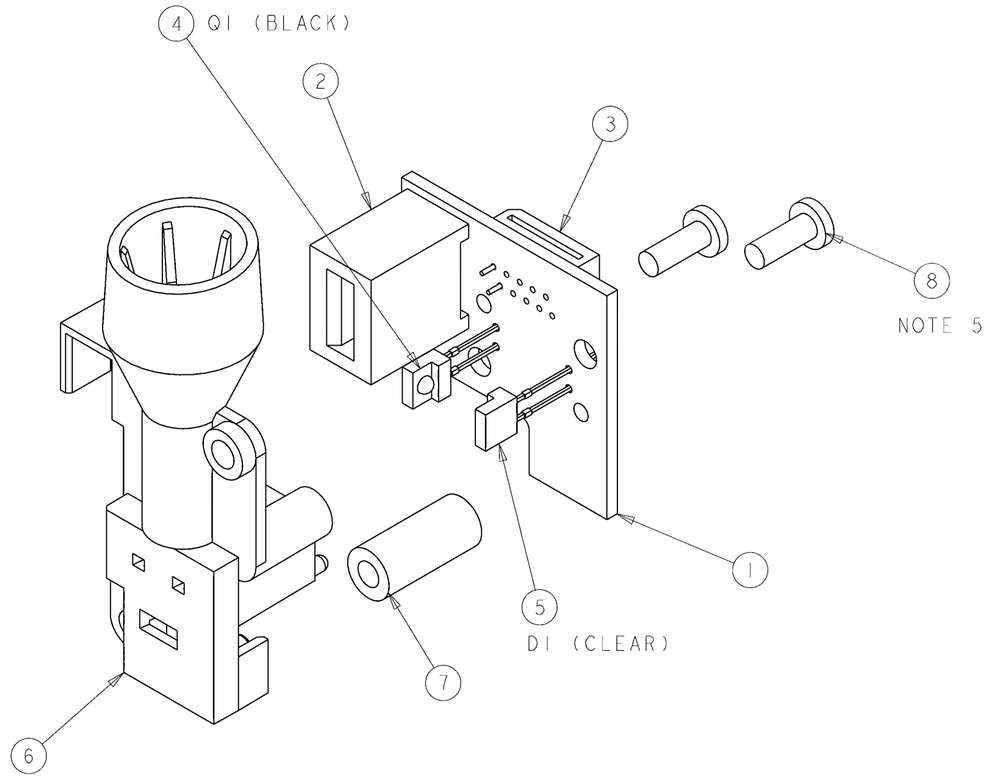
| REV | DESCRIPTION | ECN/ECO | INIT | DATE | CKD |
|---|---|---|---|---|---|
| A | RELEASE TO PROD. ENG. | AMT41550-3 | JRS | 9/13/00 | T.W. |
| B | REVISED .060 MAX. DIM. | AMT41550-14 | JRS | 11/5/00 | T.W. |
| C | REMOVE B.O.M. (TABLE) | AMT41550-15 | JRS | 11/15/00 | T.W. |

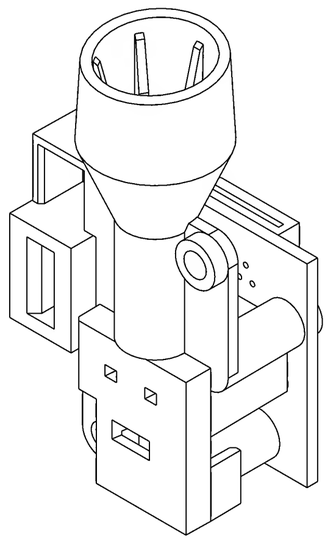





SECTION IR-IR



NOTES:
1. ASSEMBLY TO CONFORM TO THE LATEST REVISION OF IPC-A-610 CLASS 2 STANDARDS FOR ELECTRONIC ASSEMBLIES, UNLESS OTHERWISE SPECIFIED. REWORK IS ACCEPTABLE IF IT CONFORMS TO THE LATEST REVISION OF IPC-R-700C.
2. COMPLETE PCB ASSEMBLY TO BE LABELED WITH:
   -WELCH ALLYN ASSEMBLY PART NUMBER
   -REVISION LEVEL
   -DATE CODE (WEEK YEAR eg 2200)
4. PACKAGING TO BE APPROVED BY WELCH ALLYN.
5. TORQUE SCREWS TO 9-10 inlbs.
6. SENSORS TO BE BOTTOMED IN PROBE HOUSING.
7. TRIM LEADS OF ITEM 4 (QI) AND ITEM 5 (DI) TO DIMENSION SHOWN.

| | |
|---|---|
| THIS DWG -501 | - |
| PART NO. | DESCRIPTION |

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| | | |
|---|---|---|
| DRAWN TJW | DATE 08-Aug-00 | Welch Allyn® |
| APPROVED T. WAWRO | DATE 9/26/00 | MATERIAL: - |
| REL TO PROD J. HOWARD | DATE 9/26/00 | FINISH: - |
| T. EDMONDSON | 9/26/00 | TITLE: ASSY. TEMPERATURE POD PCB |
| CAD SOFTWARE: | ProE | |
| TRANSLATED FROM: | | |

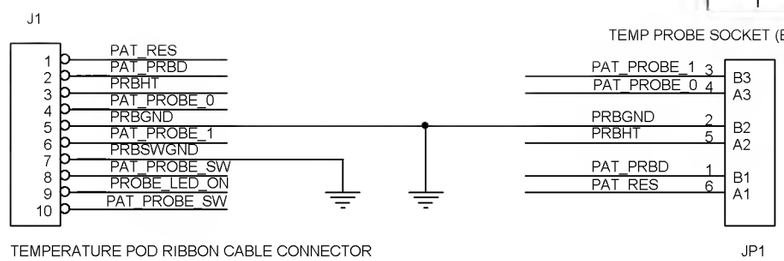
UNLESS OTHERWISE SPECIFIED
TOLERANCES DIMENSIONS ARE IN INCHES
.XX = ±.02
.XXX = ±.005
ANGLES ±2°

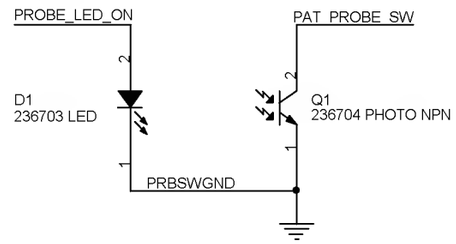
| | | |
|---|---|---|
| C | DRAWING NO. 421105 | REV C |
| SCALE 2.000 | SHEET 1 of 1 | |

| REV | DESCRIPTION | ECN | INIT | DATE | APPROVAL |
|---|---|---|---|---|---|
| A | RELEASE TO PRODUCTION | AMT41550-3 | WNC | 09-27-00 | KNUT SPANG |
| | | | | | |
| | | | | | |

CONNECTION TO J1 OF SPOT MAIN PCB

10
9
8
7
6
5
4
3
2
1




| REV | REVISION DESCRIPTION | ECN | INIT | DATE | APPRV |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

DRAWN WILL CUIPYLO — DATE 09-08-00

APPROVED KNUT SPANG — DATE 09-27-00

REL TO PRODUCTION JERRY HOWARD — DATE 09-27-00

**Welch Allyn**

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TITLE: SPOT CHECK TEMPERATURE POD PCB

Copyright Tuesday, September 26, 2000

Size B | DWG NO 421107 | Sheet 1 of 1 | Rev A

## Section 7 Repair Test Specifications

# Repair Test Specifications

# Spot Vital Signs

Original Date: 16 August 2000
Current Revision Date: 4 January 2001
Current Revision Number: 1.4

File: 126P182.DOC

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## General Notes

**Note 1:** The word "Unit" throughout this document refers to the Spot Vital Signs with out pneumatics (tubing and cuff), temperature probe, SpO2 probe, and main battery attached, unless other wise noted.

**Note 2:** Standard test voltage unless otherwise stated is 6.5 (+0/- 0.25) Vdc.

**Note 3:** All test are performed utilizing the Repair Software for the Spot Vital Signs or following the procedures called out in the Spot Service Manual.

**Note 5:** Unless otherwise stated, all calibrated volumes will be +/- 10cc of the stated volume.

**Note 6:** Unit software for the Spot Vital Signs will be equal to or greater than "1.00" for "Spot" software (SW 1) and equal to or greater than "1.00" for ModB software (SW2). If the unit has Nellcor SpO2, the SpO2 software will be equal to or greater than "1.2.0.0." If the unit has temperature, the temperature software will be equal to or greater than "2.1."

# Repair Test

## General Unit Test

### *A-D Noise Test*

The A-D Noise Test is defined as the amount of noise on the Unit A-D pressure channel, over a 1 second sample time while 0.0 mmHg is applied to the Unit pressure port. The maximum limit is 0.050 mmHg.

### *Leak Test*

Leak Test is defined as the amount of pressure drop that is recorded over a 15 second interval with a 100cc volume attached to the Unit pressure port and that volume having a stabilized pressure of 250 mmHg. The limit is 5 mmHg max

### *Inflation Test*

Inflation Test is defined as the amount of time the Unit pump can inflate a 250cc volume from 5 mmHg to 210 mmHg. The limit is 7 seconds, max.

### *Dump Test*

Dump Test is defined as the amount of time it takes the Unit to deflate a 500cc volume from 260 mmHg to less than 15 mmHg. The limit is 10 seconds.

### *Pneumatic Calibration*

**Note:** The Unit can not be calibrated if the internal temperature is beyond 32'C.

The unit will be calibrated with 0 and 250 mmHg applied to the pressure port with the following algorithm:

-Adjust the pressure calibration 'offset' value with the following formula.( (Last autozero pressure value + current unit pressure) * 16384 /(pressure offset correction value + pressure gain correction value)). The pressure offset value must be -15384 to 15384.

-The Unit must be able to successfully perform an autozero.

-Adjust the pressure gain value until the unit pressure deviation from the applied pressure is less than 0.1 mmHg. Continue to utilize the following formula until the pressure is less than 0.1 mmHg. (applied pressure / unit pressure) * pressure gain value. The pressure gain value must be 1000 to 31767

When the pressure transducer calibration is performed(only when successful), a calibration signature will be stored in the Unit memory. The calibration signature can be any of up to four printable characters.

When the pressure transducer calibration is performed(only when successful), the date and time of that calibration will be stored in the Unit memory.

### *Pneumatic Accuracy Test*

**Note:** This test will be conducted in the configuration mode of the Spot Vital Signs.

Perform Autozero before the start of this test. The Pneumatic Accuracy test is defined as the comparison of the Unit pressure measurement and applied pressure at 0, 50, 175, and 275. The maximum limit for the 0 reading will be +/- 1.0 mmHg, all others +/- 3.0 mmHg.

### *Valve Control Test*

With a 100 cc volume connected to the Unit pressure port and pressurized to 160 mmHg, give Unit commands to open the valve for 10 mSec., 15 mSec., and 25 mSec. And record each pressure drop. The pressure drops will be 4 to 12 mmHg, 4 to 15 mmHg, and 4 to 25 mmHg respectively.

### *Battery Calibration Requirements*
The Unit battery voltage measurement circuit will be calibrated at 5.5 +0.2/- 0 VDC.

The battery calibration factor must be 14,384 to 18,384.

When the Unit battery measurement circuit is successfully calibrated, a calibration signature will be stored in the Unit memory. The calibration signature can be any of up to four printable characters.

### *Blank Mode Current Test*
The Blank Mode Current Test is defined as the amount of current that is drawn through the battery terminals, all LCD segments are turned off, the back light is off, the SpO2 mode is turned off. The limit is 200 mA. max.

### *Back Light(Idle) Current Test*
The Back Light Current Test is defined as the amount of current that is drawn through the battery, all LCD segments are turned on, the back light turned on, the SpO2 mode is turned off. The limit is 400 mA. Max.

### *Valve/Pump Mode Current Test*
The Valve/Pump Mode Current Test is defined as the amount of current that is drawn through the battery terminals, the Unit is in the Blank Mode, Unit valve and pump actuated to on. The limit is 700 mA, max.

### *IR Interface Tests*
The Unit will be able to communicate through the IR Port. Opening the IR Port and successfully issuing a command with no errors returned will be sufficient to test the IR Interface.

### *Interface Test*
When given the proper commands, the Spot Display will turn on all segments, turn off all segments, turn on the back light or turn off the back light. When give the proper command, the spot unit buzzer will come on to ensure operation. The pass/fail criteria is subjective to the user.

## Temperature Option Requirements

### *Accuracy Testing*
The accuracy of the temperature module must be within +/- 0.2F for readings with a nominal temperature of 97.3F (36.3C) using a Cal Key (5200-25).The unit must be able to read a temperature of 96.4F (35.8C) and a temperature of 106F (41.1C) within +/- 0.3F (+/-0.2C) using a Welch Allyn 9600 Calibrator.
Note: if using a water bath to take temperatures, the temperature of the bath should be between 84F and 106F (28.8 and 41.1C)and the reading must agree within +/-1.0F (0.8C) measuring against a temperature standard that is accurate to within +/-1.0 F (0.8C).

### *Temperature Probe Test*
The unit will display "188.8" and then "ORL" once the oral probe is removed from the probe housing.

## SpO2 Option Requirements

**Note:** These tests are only performed if configured forSpO2.

### *SpO2 Functional Test*
The SpO2 Functional Test is defined as the ability of the Unit to correctly report an applied SpO2 signals from a Nellcor SRC2 Simulator. The applied signals are 81% O2, 112 BPM at a saturation level of 100. The limits are +/-3 counts for the O2 readings and +/- 3 counts for BPM readings.

### *SpO2 Mode Current Test*

The SpO2 Mode Current Test is defined as the amount of current, less the Blank Mode Current, that is drawn through the battery terminals, placing the Unit in the Blank Mode, actuating the SpO2 mode and applying any SpO2 signal to the Unit. The maximum limit is 120 mA, max.

## Fail Safe Testing

### *Over Pressure Test*

The unit will be able to detect over pressure on the unit's pneumatic system between 296.0 mmHg and 329 mmHg.

### *Over 15 mmHg*

The unit will be able to detect if the static pressure has been over 15 mmHg for 180 second.